

Technology Review

Edited at the Massachusetts Institute of Technology

THE
NEW WAVE
IN THE EARTH
SCIENCES



technology review

Published by MIT

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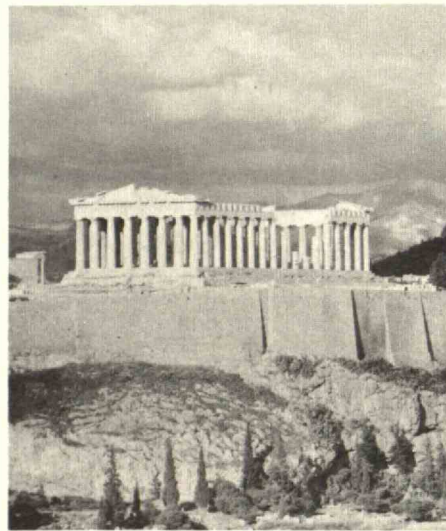


THE ORIENT

29 DAYS \$2350

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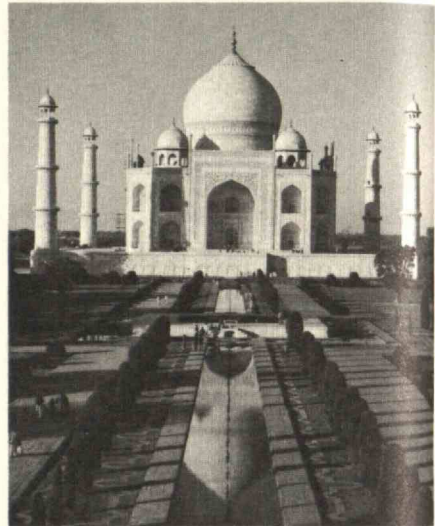


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23 DAYS \$1875

This original itinerary explores in depth the magnificent scenic, cultural and historic attractions of Greece, the Aegean, and Asia Minor—not only the major cities but also the less accessible sites of ancient cities which have figured so prominently in the history of western civilization, complemented by a cruise to the beautiful islands of the Aegean Sea. Rarely has such an exciting collection of names and places been assembled in a single itinerary—the classical city of ATHENS; the Byzantine and Ottoman splendor of ISTANBUL; the site of the oracle at DELPHI; the sanctuary and stadium at OLYMPIA, where the Olympic Games were first begun; the palace of Agamemnon at MYCENAE; the ruins of ancient TROY; the citadel of PERGAMUM; the marble city of EPHEBUS; the ruins of SARDIS in Lydia, where the royal mint of the wealthy Croesus has recently been unearthed; as well as CORINTH, EPIDAUROS, IZMIR (Smyrna) the BOSPORUS and DARDANELLES. The cruise through the beautiful waters of the Aegean will visit such famous islands as CRETE with the Palace of Knossos; RHODES, noted for its great Crusader castles; the windmills of picturesque MYKONOS; and the charming islands of

PATMOS and SANTORINI. Total cost is \$1875 from New York. Departures in April, May, July, August, September and October 1975 (extra air fare for departures in July and August).



MOGHUL ADVENTURE

29 DAYS \$2295

An unusual opportunity to view the outstanding attractions of India and the splendor of ancient Persia, together with the once forbidden mountain-kingdom of Nepal. Here is truly an exciting adventure: India's ancient monuments in DELHI; the fabled beauty of KASHMIR amid the snow-clad Himalayas; the holy city of BANARAS on the sacred River Ganges; the exotic temples of KHAJURAHOO; renowned AGRA, with the Taj Mahal and other celebrated monuments of the Moghul period such as the Agra Fort and the fabulous desert city of Fatehpur Sikri; the walled "pink city" of JAIPUR, with an elephant ride at the Amber Fort; the unique and beautiful "lake city" of UDAIPUR; and a thrilling flight into the Himalayas to KATHMANDU, capital of NEPAL, where ancient palaces and temples abound in a land still relatively untouched by modern civilization. In PERSIA (Iran), the visit will include the great 5th century B.C. capital of Darius and Xerxes at PERSEPOLIS; the fabled Persian Renaissance city of ISFAHAN with its palaces, gardens, bazaar and famous tiled mosques; and the modern capital of TEHRAN. Outstanding accommodations include hotels that once were palaces of Maharajas. Total cost is \$2295 from New York. Departures in January, February, March, August, September, October and November 1975.

SOUTH AMERICA

32 DAYS \$2325

From the towering peaks of the Andes to the vast interior reaches of the Amazon jungle, this tour travels more than ten thousand miles to explore the immense and fascinating continent of South America: a brilliant collection of pre-Colombian gold and a vast underground cathedral carved out of a centuries-old salt mine in BOGOTA; magnificent 16th century churches and quaint Spanish colonial buildings in QUITO, with a drive past the snow-capped



peaks of "Volcano Alley" to visit an Indian market; the great viceregal city of LIMA, founded by Pizarro, where one can still see Pizarro's mummy and visit the dread Court of the Inquisition; the ancient city of CUZCO, high in the Andes, with an excursion to the fabulous "lost city" of MACHU PICCHU; cosmopolitan BUENOS AIRES, with its wide streets and parks and its colorful waterfront district along the River Plate; the beautiful Argentine LAKE DISTRICT in the lower reaches of the Andes; the spectacular IGUAZU FALLS, on the mighty Parana River; the sun-drenched beaches, stunning mountains and magnificent harbor of RIO DE JANEIRO (considered by many the most beautiful city in the world); the ultra-modern new city of BRASILIA; and the fascination of the vast Amazon jungle, a thousand miles up river at MANAUS. Total cost is \$2325 from Miami, with special rates from other cities. Optional pre and post tour visits to Panama and Venezuela are available at no additional air fare. Departures in January, February, April, May, July, September, October and November 1975.



THE SOUTH PACIFIC

29 DAYS \$2685

An exceptional and comprehensive tour of AUSTRALIA and NEW ZEALAND, with optional visits to FIJI and TAHITI. Starting on the North Island of New Zealand, you will visit the country's major city of AUCKLAND, the breathtaking "Glowworm Grotto" at WAITOMO, and the Maori villages, boiling geysers and trout pools of ROTORUA, then fly to New Zealand's South Island to explore the startling beauty of the snow-capped SOUTHERN ALPS, including a flight in a specially-equipped ski plane to land on the Tasman Glacier, followed by the mountains and lakes of QUEENSTOWN with a visit to a sheep

station and a thrilling jet-boat ride through the canyons of the Shotover River. Next, the haunting beauty of the fiords at MILFORD SOUND and TE ANAU, followed by the English charm of CHRISTCHURCH, garden city of the southern hemisphere. Then it's on to Australia, the exciting and vibrant continent where the spirit of the "old west" combines with skyscrapers of the 20th century. You'll see the lovely capital of CANBERRA, seek out the Victorian elegance of MELBOURNE, then fly over the vast desert into the interior and the real OUTBACK country to ALICE SPRINGS, where the ranches are so widely separated that school classes are conducted by radio, then explore the undersea wonders of the GREAT BARRIER REEF at CAIRNS, followed by a visit to SYDNEY, magnificently set on one of the world's most beautiful harbors, to feel the dynamic forces which are pushing Australia ahead. Optional visits to Fiji and Tahiti are available. Total cost is \$2685 from California. Departures in January, February, March, April, June, July, September, October and November 1975.



MEDITERRANEAN ODYSSEY

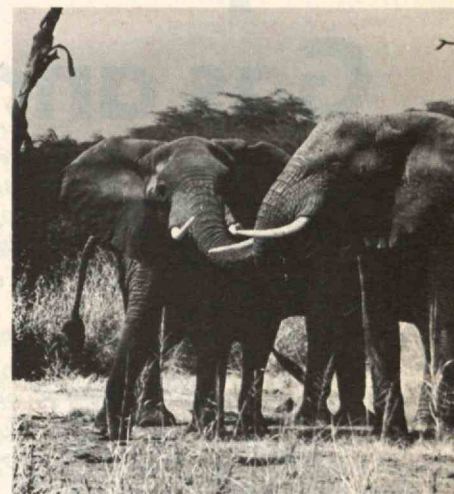
22 DAYS \$1695

An unusual tour offering a wealth of treasures in the region of the Mediterranean, with visits to TUNISIA, the DALMATIAN COAST of YUGOSLAVIA and MALTA. Starting in TUNIS, the tour explores the coast and interior of Tunisia: the ruins of the famed ancient city of CARTHAGE as well as the ruins of extensive Roman cities such as DOUGGA, SBEITLA, THUBURBO MAJUS and the magnificent amphitheater of EL DJEM, historic Arab towns and cities such as NABEUL, HAMMAMET, SOUSSE and KAIROUAN, the caves of the troglodytes at MATMATA, beautiful beaches along the Mediterranean coast and on the "Isle of the Lotus Eaters" at DJERBA, and desert oases at GABES, TOZEUR and NEFTA. The beautiful DALMATIAN COAST of Yugoslavia is represented by SPLIT, with its famed Palace of Diocletian, the charming ancient town of TROGIR nearby, and the splendid medieval walled city of DUBROVNIK, followed by MALTA, with its treasure house of 17th and 18th century churches and palaces, where the Knights of St. John, driven from the Holy Land and from Rhodes, withstood the epic siege of the Turks and helped to decide the fate of Europe. Total cost is \$1695 from New York. Departures in March, April, May, June, July, September and October, 1975 (additional air fare for departures in June and July).

EAST AFRICA

23 DAYS \$2100

An exciting, unforgettable luxury safari which covers East Africa from the wilderness of the interior to the tropics of the coast on the Indian Ocean: game viewing in the semi-desert of Kenya's Northern Frontier district at SAMBURU RESERVE; a night at world-famous TREETOPS in the ABERDARE NATIONAL



PARK; the spectacular masses of pink flamingos at LAKE NAKURU; black-maned lions and multitudes of plains game in MASAI-MARA RESERVE; the vast stretches of the SERENGETI PLAINS, with leopard, cheetah and large prides of lions, as well as great herds of zebra, wildebeest, and impala; the permanent concentrations of wildlife on the floor of the NGORONGORO CRATER; tree-climbing lions and herds of elephant along the shores of LAKE MANYARA; and the beaches and tropical splendor of historic MOMBASA on the Indian Ocean, with its colorful old Arab quarter and great 16th century Portuguese fort, and with optional excursions to LAMU or ZANZIBAR. The program also includes a visit to the famous excavations at OLDUVAI GORGE and special opportunities to see tribal dancing and the way of life of the Kikuyu and Masai tribes, as well as the great safari capital of NAIROBI. Optional post-tour extensions are also available to ETHIOPIA and the VICTORIA FALLS. Total cost is \$2100 from New York. Departures in January, February, March, May, June, July, August, September, October, November and December 1975.

* * *

Rates include Jet Air, Deluxe Hotels, Most Meals, Sightseeing, Transfers, Tips and Taxes.

Individual brochures on each tour are available, setting forth the detailed itinerary, departure dates, hotels used, and other relevant information. Departure dates for 1976 are also available.

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Behind the news: Exploding the Russian Car Gas and Cheaper food? To Hi

SOVIET ENERGY: An Internal Assessment. By Marianna Slocum; an article in the Oct.-Nov. issue of the Technology Review published by the Massachusetts Institute of Technology, Cambridge, Mass.

Revisiting the South Middle

There is a well-known article in MIT's magazine, "Technology Review," that says the 1970s will mark the beginning of cheap food for the masses. The article, by Jerome F. Hanse, a News Staff Writer, says that the U.S. government's price controls on food are a major factor in the high cost of food. He says that the government's price controls are a major factor in the high cost of food. He says that the government's price controls are a major factor in the high cost of food.

Studying ice age

CAMBRIDGE
Scientists may learn to predict world food supplies of the future by studying the ice ages of the past, says a meteorologist at the Massachusetts Institute of Technology. Recent price increases for wheat and soybeans, as well as the famine in drought-stricken Africa, can be traced to climatic changes that could be predictable, says Prof. Reginald D. E. Newell.

In an article in the December issue of Technology Review, the MIT journal of science, Newell suggests that if men can learn what causes ice ages, they may be able to anticipate the smaller climatic changes that can decrease food supplies and bring famines. He says that the government's price controls are a major factor in the high cost of food.

By Robert Cooke
Globe Staff

One of the important reasons of the food prices are getting out of control, two management specialists in the food industry aren't talking to each other enough. According to Dr. Gordon F. Bloom of MIT and Dr. Ronald C. Curhan of Boston University, faster development of new food technology could lead to better, cheaper food distribution.

Cheaper food? by 50%

Most of the suggestions, however, have little chance of being adopted by the government unless ordered by the government. One physicist, says Dr. Cohn, a physicist at MIT, is loose on tolerances. These are just two conclusions advanced in a series of articles on the automobile in the February issue of Technology Review, the Massachusetts Institute of Technology's national journal. Authors of the articles are: Jerome F. Hanse, News Staff Writer; Marianna Slocum, MIT; and Jean-Claude Derian, MIT.

Special to the Eagle

CAMBRIDGE, Mass.
Today's automobile — big, more comfortable, safer, more automatic — consumes more energy than the average car of the 1930s.

Though automobiles are necessary inefficient, substantial energy economies in manufacture and in operation are possible without new technology.

These are just two conclusions advanced in a series of articles on the automobile in the February issue of Technology Review, the Massachusetts Institute of Technology's national journal. Authors of the articles are: Jerome F. Hanse, News Staff Writer; Marianna Slocum, MIT; and Jean-Claude Derian, MIT.

Technology Review

M.I.T.'s national magazine of new developments in technology and their impact on human affairs.

For subscription and advertising information write:
Room E19-430,
Massachusetts Institute of Technology,
Cambridge, Mass. 02139

Technology Review



Technology Review, Reg. U.S. Patent Office, is published eight times each year (in October/November, December, January, February, March/April, May, June, and July/August) at the Massachusetts Institute of Technology; two special editions are provided for graduate (pp. 1-96) and undergraduate (pp. 1-128) alumni of M.I.T. Entire contents copyright 1975 by the Alumni Association of the Massachusetts Institute of Technology. Technology Review is printed by The Lane Press, Inc., Burlington, Vt. Second class postage paid at Boston, Mass., and at additional mailing offices.

Inquiries regarding editorial contents, subscriptions, and advertising should be addressed to: Technology Review, Room E19-430, Massachusetts Institute of Technology, Cambridge Mass., 02139. Telephone area code (617) 253-4872.

Price: \$1.75 per copy, \$12 per year in the United States, Canada and Mexico, \$22 overseas. Please allow three weeks for changes of address, and give both old and new addresses in all requests.

Technology Review is represented for advertising by: Littell-Murray-Barnhill, Inc., 60 E. 42nd Street, New York, N.Y., 10017, telephone (212) 867-3660; Cole, Mason and Deming, 221 No. LaSalle Street, Chicago, Ill., 60601, telephone (312) 641-1254; Zander, Coughlin and Thompson, 5478 Wilshire Boulevard, Los Angeles, Calif., 90036, telephone (213) 938-0111 and 22 Battery Street, San Francisco, Calif., 94111, telephone (415) 398-4444.

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Articles

The articles in this issue were originally presented as contributions to a commemorative symposium marking the tenth anniversary of the Cecil and Ida Green Building at M.I.T. (see "The First Line," page 4). It is obvious, then, that this issue of the *Review* is dedicated to Dr. and Mrs. Green (below), whose gift made possible that Building and — in a very real sense — many of the achievements which our authors chronicle.



Plate Tectonics and Mineral Deposits
Patrick M. Hurley

Mineral Resources on the Ocean Floor
Gustaf Arrhenius

The Physical Basis for Earthquake Prediction
William F. Brace

New Opportunities for Offshore Petroleum Exploration
Kenneth O. Emery

Solar Energy in Earth Processes
Vincent E. McKelvey

Petroleum Resources: How Much Oil and Where?
John D. Moody and Robert E. Geiger

The Geology and Geophysics of Geothermal Energy
James B. Combs

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The marketplace as a predictor of entrepreneurial success; and other observations by and about the Massachusetts Institute of Technology

On the world's largest extended-chain polymer crystals.



At the Materials Research Center Drs. R.H. Baughman and K.C. Yee have synthesized large polymer crystals which have extraordinary properties and unique internal structures. The crystals, which are formed by solid state reaction, have fully conjugated backbone structures. In addition to previously known single chain polymers, they include two new classes of polymeric molecules designated "ring-bridged" and "cyclically-bound ladder" polydiacetylenes. In appearance, the crystals exhibit metallic luster, intense coloration, and dichroism. They have negative macroscopic thermal expansivities, very high strengths and are semi-conductors.

Ordinary polymer crystals are microscopic in size and typically consist of molecular chains folded back upon themselves much like ribbon candy. In contrast, Baughman's and Yee's new polymer crystals are up to 15 cm in length and consist of parallel, unfolded chains. Their unusual properties are associated with the nearly perfect alignment of the molecular chains and the absence of gross structural defects. They are made by first crystallizing the molecules of an appropriate monomer and then photopolymerizing the monomer crystal with ultra-violet light or gamma rays.

Availability of large monocrystals provides a unique opportunity to explore the behavior of nearly defect-free polymeric materials. Fundamental understanding of the solid-state synthetic method has allowed template-like control of polymer structure on three levels: molecular, crystallographic and morphological. This provides a capability for synthetic tailoring of polymers to optimize properties dependent upon molecular structure and crystalline perfection.

Allied Chemical Corporation/Materials Research Center
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The First Line

The New Wave in the Earth Sciences

Nothing less than a revolution has shaken the earth sciences in the decade just ending — a truly "new wave" of understanding of the solid earth and its remarkable dynamics. Scientific achievement has rarely been so large and so compressed — so much of what seemed unknowable interrelated so quickly into a consistent whole by a single grand conception.

No accident that as this decade of discovery opened, M.I.T. in 1964 dedicated new earth science laboratories made possible by Dr. and Mrs. Cecil H. Green. Those laboratories have since been — in the words of Professor Frank Press, Head of the Department of Earth and Planetary Sciences — "a hotbed in the revolution."

Two reasons, then, to celebrate the achievements of this remarkable decade.

The papers published in this issue of *Technology Review* were commissioned for just such a celebration — a symposium bearing the title of this issue — in Cambridge late last year. They are at once a tribute to Dr. and Mrs. Green (Dr. Green, who graduated from M.I.T. in the Class of 1923, was a founder of Geophysical Service, Inc., and is Honorary Chairman of Texas Instruments, Inc.) and an unusual experience which the editors cherish for the *Review's* readers. — J.M.

(In addition to all the major articles in this issue of the *Review*, the symposium included papers on geological structures and geophysical exploration by David Strangway of the University of Toronto and M. Nafi Toksoz of M.I.T. which will appear in *Technology Review* for May. The entire collection will then made available as a commemorative volume, the publication of which will be announced in the *Review*.)

Letters

The Dynamics of Soviet Energy

Marianna Slocum's ("Soviet Energy: An Internal Assessment," October/November, 1974, pp. 16-33) basic thesis of a depletion of Soviet energy reserves in the demand area of the European U.S.S.R. is well documented, but Ms. Slocum minimizes the development effort that the Russians have already achieved in the remote oil and gas reserves of Siberia.

In one of the more extreme statements, based on outdated Soviet sources, she says: "The possibility of piping crude oil from the Siberian (Tyumen) fields to the Western U.S.S.R. is rather limited because much of the Tyumen oil will be used in Siberia, Kazakh S.S.R. and the Far East." She then quotes a 1967 source to the effect that oil is "still brought to Siberia."

The facts are that the oil flow in the old pipeline network from the Volga-Urals fields to Siberia was reversed in 1970, an additional pipeline from the Tyumen fields to the Volga was completed in 1973, and was extended in 1974 to the Black Sea oil-exporting port of Novorossiysk. The Tyumen fields in 1974 contributed one-fourth of the Soviet Union's total petroleum production. This should answer the rhetorical question raised by Ms. Slocum: "When, if at all, will a surplus of Siberian fuel be available for delivery to the energy-hungry areas?"

Similarly, development has been proceeding in the West Siberian gas fields despite their remote location, even farther north than the Tyumen oil fields. Last year (1974) these gas fields contributed one-tenth of Soviet natural gas, and a pipeline to Moscow was completed.

If the status of oil and gas pipelines shown on the two-page map with the article is any indication, the underlying information is about five years old. The oil pipeline to the Baltic Sea terminal of Ventspils, shown as "planned or under construction" on the map, has in fact been in operation since 1968. The gas pipeline from the Komi A.S.S.R. to the Central Russian distribution network was completed in early 1970; the gas pipeline to Alma-Ata was opened in 1971; and so forth.

Part of the problem appears to have been the use of old Soviet sources in a highly dynamic situation. Moreover the author seems to have underestimated the Soviet economic planners' determination to develop domestic energy resources despite remote location and high cost simply because fuel must be provided for the energy-poor economic heartland in the European portion of the U.S.S.R. To belabor the Soviet Union's dependence on Western assistance, as Ms. Slocum appears to do, may minimize Moscow's ability to develop resources at its own pace, despite the evident difficulties, and may yield misleading conclusions.

Theodore Shabad
New York, N.Y.

The writer is editor of the translation journal Soviet Geography: Review and Translation, which carries regular news notes on Soviet resource development and pipeline construction, and author of the book Basic Industrial Resources of the U.S.S.R. — Ed.

Plutonium Is not Inevitable

In "Plutonium: A 'Hot' Potato" (January, pp. 50-51) you state that plutonium is an unavoidable by-product of nuclear fission. Fortunately that is not correct. The light-water breeder reactor (LWBR), now under development by the Division of Naval Reactors of the Energy Research and Development Agency (E.R.D.A.), uses a thorium-232—uranium-233 fuel system. The thorium is transformed to

U-233 by capturing a neutron and subsequently decaying. The U-233 (which is not a naturally-occurring isotope) is a fertile material and suitable for use in a nuclear core. And it is considerably less toxic and dangerous than plutonium.

The principal drawback of the U-233—Th-232 fuel system is that it does not breed as well (at least on paper) as the U-238—Pu-239 system used in the Liquid Metal Fast Breeder Reactor (LMFBR) program. However, the LWBR program is much closer to fruition (a demonstration core will be operational in the Shippingport Atomic Power Station by 1976) and employs well-tested pressurized water reactor technology instead of developmental liquid metal technology. And LWBR cores can be installed in the many operating pressurized water reactor plants throughout the U.S. with minor plant modifications. LMFBR systems require a new, different type of plant design.

Richard A. Guida
Arlington, Va.

The Dilemmas of World-Wide Hunger

"The World-Wide Confrontation of Population and Food Supply" (December, 1974, pp. 12-19) clearly notes how growing population underlies the existing food shortage problems. At the same time it shows how the food shortage stifles resolution of the population problem. What a paradoxical position to be in!

It also notes how the possibility of any solution is rapidly decreasing with the advance of time. (Of course, this disregards nature's catastrophic solutions.) It seems that the only "humane" solution would require supplying enough food now to achieve population stabilization.

However, have all issues been correctly considered? It is noted that India has approximately the same amount of land under cultivation as does the U.S., though the productivity is only 40 per cent of ours due to lack of fertilizer and irrigation. It is also noted that India will require an additional 8 or 9 million tons of wheat this year to stave off starvation. The question is raised: "Will the industrial countries, with their large herds of livestock, be prepared to cut their herds back?"

The question is correct, but it is misdirected. India is reported to have a larger number of cattle than does the U.S. And few of this vast herd serve as a source of food for India's overflowing populace. Even if India is unable to achieve a stable human population, a drastic decrease in cattle population should make much more food available to the people.

I consider this a rational course of action. But it is important to note, too, that — like the "Green Revolution" — this is merely a stop-gap measure. If the human population continues to grow, any food supply "solutions" merely postpone an inevitable day of reckoning.

Avi Ornstein
New Britain, Conn.

Professor Scrimshaw responds:

U.S. cattle are grass-fed for the first two thirds of their lives, and then sent to a feed lot. During the last four to six weeks in the feed lot, to add 100 pounds of weight, each animal consumes 1,000 pounds of grain. Unfortunately, most of this weight is fat, which is later cut off or which often contributes undesirably to obesity or atherosclerosis. With 80 million cattle slaughtered per year, the potential saving if beef cattle could be brought to market with less fat is 40 million tons of grain. Cattle in India do not eat grain, but neither do they make a contribution to the meat supply. Many of them do furnish some milk, which is prized. The final point of the letter is certainly correct: If human numbers continue to grow at explosive rates, finite environmental limits will be reached in a few decades.

Trips as Social Experience

"Is This Trip Necessary?" (December, 1974, p. 64) gives insufficient weight to the psychological factors involved, though these are mentioned as an afterthought in the last paragraph.

People go to movies and legitimate theater not because they lack television sets that work, or because they want to see a particular production that is not yet on television, but at least in part because theater attendance in some subtle way is a social experience that watching television is not. Can you imagine professional football becoming a television show only, with no live audience? This is theoretically possible, if your theories are limited. But I think it unlikely.

A telephone conference (or video when that comes along) with business associates you know well is fine; you know them well because of prior personal contacts. But who would trust negotiating substantial government or business matters with strangers other than in person? It isn't just a matter of habit; we rely on subtle forms of communication in person that don't go over electronically, and shouldn't be expected to.

Our modern life tends to isolate people in capsules with less social interchange at a deep level than the human spirit seems to demand (as *Future Shock* tells us). In tinkering with the system we need to try to do something about this rather than, as the INTERPLAN researchers propose according to your article, "re-educate the public to drive less."

"Is this trip really necessary?" is a legitimate question. But to get a useful answer we need a sufficiently broad, and sufficiently sophisticated, definition of "necessary."

Vance A. Myers
Fairfax, Va.

Letters continued on p. 68

Ecological Magnification

Environment/Technology
by
Ian C.T. Nisbet

A commonplace observation in monitoring persistent chlorinated hydrocarbons is that residue concentrations are much higher in predatory animals than in other organisms or in the general environment. Usually residue levels are higher in herbivorous animals than in plants, higher in carnivorous animals than in herbivores, highest of all in carnivores that feed on carnivores. The spectacularly high concentrations of DDE and PCBs are thus found in fish-eating birds (such as ospreys and pelicans), bird-eating birds (such as falcons) and fish-eating mammals (such as seals and porpoises).

Scientists commonly account for these frequencies by describing persistent chemicals as "ecologically magnified" or "accumulated in food chains." With the proviso that most animals feed on more than one type of prey — so that we should speak rather of "food webs" than "food chains" — this serves as a fairly good empirical generalization. However, the simple word "accumulation" presents a misleading impression of the underlying mechanisms' simplicity: Detailed studies show that the phenomenon is quite complex and biologically interesting.

Many features of ecological magnification can be duplicated and studied under controlled conditions in the laboratory. In one simple aquarium experiment, algae accumulated dieldrin to levels 1,300 times higher than that in the ambient water, water-fleas to levels 11 times those in the algae, and guppies to levels 3.5 times those in the water-fleas. More sophisticated "model ecosystems," incorporating both terrestrial and aquatic plants and animals, have been designed at the University of Illinois. In these systems the highest concentrations were consistently observed in fish (predators) and snails (scavengers). A number of different chemicals have now been tested under identical conditions in these systems: The measured degree of ecological magnification is very closely correlated with and inversely proportional to the water-solubility of the chemical. Thus the principal force behind the phenomenon of ecological magnification appears to be the partitioning of the chemicals between

water and fat-containing organisms: The less soluble the chemicals are in water, the more strongly they are taken up into plants and animals.

A simple partitioning theory does not work quantitatively, however. Partition coefficients for DDT and DDE between fat and water are of the order of 10^8 to 10^9 ; yet in controlled experiments bio-accumulation factors (ratios of chemical levels in organisms to levels in ambient water) rarely exceed 10^5 . Thus the degree of accumulation must be limited by biological rather than physico-chemical processes.

The Equilibrium Theory

When organisms are exposed to constant levels of chlorinated hydrocarbons (either in their food or, in the case of aquatic organisms, in their water environment), the concentrations of the chemicals rise rapidly at first and then level off to reach a quasi-equilibrium. At this point the rate of chemical intake is more or less balanced by the rates of excretion and of metabolic breakdown. The slower the rate of excretion, the longer the time required to reach equilibrium and the higher the concentration in the tissues. As it happens, experiments show a good general correlation between the size of the organism and the time required to reach equilibrium. In experiments with DDT and PCBs, for example, approximate equilibrium is reached in a matter of hours in algae, days in crustaceans, weeks or months in fish, months in birds and small mammals, and several years in humans. Thus larger animals generally have more difficulty excreting these chemicals than do smaller organisms — a difference that probably has something to do with their lower metabolic rates and surface-to-volume ratios. Since predators are generally larger than their prey, this metabolic difference goes far to explain the phenomenon of ecological magnification.

So far, we have expressed in the term "ecological magnification" two rather different phenomena. Terrestrial animals (including man) ingest these chemicals primarily in their food — or sometimes by inhalation. However, aquatic animals such as fish and crustaceans ingest the



Spectacularly high levels of chlorinated hydrocarbons have been found in fish-eating birds such as this brown pelican. Scavenging animals are particularly susceptible, as their diet is more likely to include prey which has died or been weakened by exposure to the chemicals.

chemicals both in their food and directly from the water in which they live; they have to process so much water in order to obtain oxygen that the water is usually the primary route of exposure to toxic chemicals. The mechanisms are so different they are often given different names: For an aquatic animal, the uptake of a chemical from ambient water is termed "bio-accumulation"; for an air-breathing animal, uptake of a chemical from food is called "bio-magnification." "Bio-accumulation factors" for persistent chlorinated hydrocarbons are typically in the range of 10^3 to 10^5 in laboratory conditions, but "bio-magnification factors" are much more modest — typically around ten for DDT and PCBs and around one for more water-soluble chemicals such as dieldrin and lindane.

In addition to the quasi-equilibrium established between an organism and its external environment, there often appears to be an equilibrium distribution of the chemical within the organism. If the ex-

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posed animals are killed and dissected, the chemical is often found distributed among organs in a more or less constant and predictable fashion. According to the most plausible model, the chemical is absorbed into the animal and circulated through the body in the blood, reaching an independent equilibrium across the membranes which separate the blood from each organ in the body. Studies of the distribution of dieldrin in man, for example, show that it is partitioned between the blood, brain, liver, and fat in the ratios 1:4:23:136 respectively. DDE and PCBs are still more strongly partitioned into fat. The more fat an animal contains, therefore, the higher will be its average body concentration and the higher the ecological magnification ratio calculated on a whole-body basis. As a general rule, predatory animals tend to be fatter than their prey, so this fact alone contributes to the phenomenon of ecological magnification.

Non-Equilibrium in the Real World

Like most simple theories based on a few highly-controlled experiments, the equilibrium theory does not work too well in the real world. In the first place, no wild animal is ever exposed to constant levels of a chemical: Environmental residues are highly variable in space and time, so that it is unlikely that the ideal equilibrium is ever reached — except in an abstract statistical sense. For large animals, the time required to reach quasi-equilibrium is longer than annual cycles of physiological condition. Under recurrent stresses of food shortage, reproduction, etc, many wild animals deplete their fat stores periodically, releasing fat-soluble chemicals to circulate through the body at high concentrations.

Worse still, there is mounting evidence that the equilibrium theory may rest on an unsound empirical base. Several experimental studies on various animal species exposed to dieldrin have shown that tissue concentrations reach a quasi-equilibrium after about one year of exposure but then start to rise sharply again after two years. Since most research projects are funded for only about two years, we know little

Continued on p. 68

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Windmills in the History of Technology

Special Report
by
Volta W. Torrey

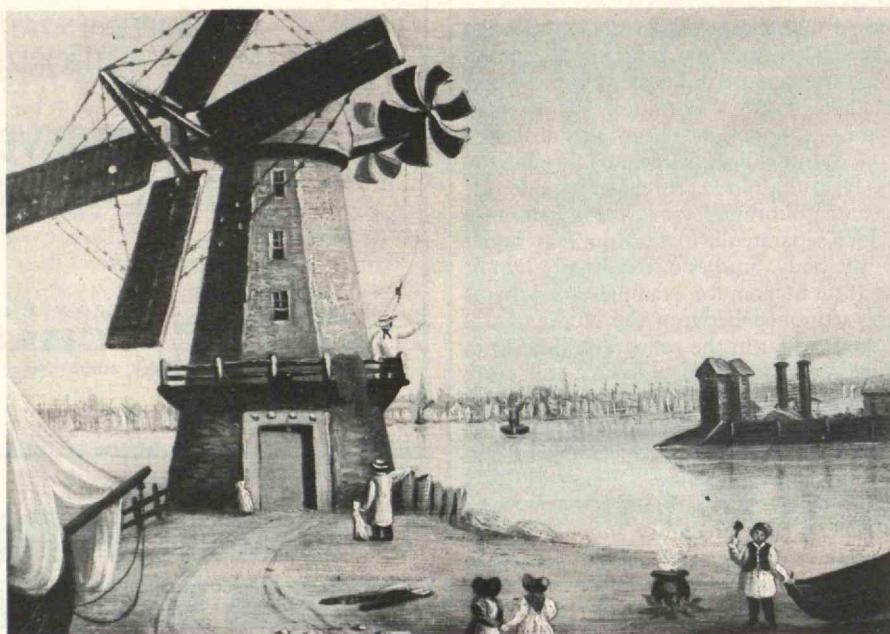
Now that we have societies to preserve everything from Johnny Cake recipes to skyscrapers, and especially now that energy is becoming a more expensive product, people are paying more attention to windmills. But it turns out that there is really very little new under the sun; most current proposals to use the wind's energy are similar to previous efforts, and so we return to history again.

The Persians built the first windmills that we know much about, and some of those primitive machines can still be found running. Their sails revolve horizontally like carousels, rather than vertically, and engineers at the Langley Research Center and elsewhere are now experimenting again with horizontal rotors. Nebraska farmers ran pumps with wooden horizontal sails in the 1800s, but now most pump water with electric motors. The only big horizontal windmill still in use in this country that I have heard about is in Winnemucca, Nevada, where its owner lets the wind generate power to light a sign for a roadside business.

European settlers in the Caribbean Islands promptly built stone towers for big vertical sails. Some of those towers are still there, and the Brace Research Institute of Canada has been using one of them as a test stand for new rotors. The Spaniards built the sturdy giants that unhorsed Don Quixote, but no traces of windmills have been found at their missions north of the Gulf of Mexico.

On our Atlantic Coast the first windmill went up a few miles from Jamestown in Virginia. The English colonists there perched millhouses on posts so that the whole shebang could be turned to face a favorable wind from any direction. Those pivoted structures seldom lasted long, but post mills have recently been reconstructed in Virginia and Maryland. An English millwright is working on one this fall that is scheduled to be put up in 1976 on Windmill Point, the site of our country's first wind-driven mill.

Post mills were soon replaced nearly everywhere by smock mills. On them only the cap or bonnet had to be turned to keep the sails facing the wind. The Dutch lined the shore of Manhattan Island with



While the Dutch were its owners, their influence on Manhattan Island was unmistakable: the shores of the island — and of what is now New Jersey (above) and Long Island as well — were lined with windmills used for powering all sorts of

pumps and mills. None survives in the New York City environs, but many similar artifacts of America's colonial era remain in the East; the author pleads for their continued preservation. (Photo: Bettman Archive)

handmade windmills. The last one in New York City burned down a few dozen years ago, but in smaller communities numerous examples of early English smock mills have been successfully saved for centuries.

Individual owners were fond of those windmills, and saving them was often regarded as women's work. The first community effort to preserve one was begun in Jamestown, R.I., in 1903 by ladies who were dismayed by the neglect of an old English mill there. At whist and garden parties they raised a few hundred dollars to buy it, and entrust it to the Jamestown Historical Society. Since then that Society has kept it in running order most of the time. Last spring a sudden storm damaged it so severely that its four arms had to be removed, but they will be replaced soon.

In England, the Society for the Preservation of Ancient Buildings that William Morris founded in 1877 did very little

about windmills until 1929. Even the Dutch let most of their windmills decay until *De Hollandische Molen* was organized. It has been the world's most successful windmill preservation society; the queen and celebrities from all over the world helped its members observe the Dutch society's golden jubilee in 1973.

Two of the most powerful Dutch windmills ever built still stand on a bluff overlooking the Pacific in San Francisco's Golden Gate Park where they once pumped water. They have not been used for many years and are in sad shape. But Eleanor Rossi Crabtree, the daughter of a former mayor, is currently spearheading a drive to raise several hundred thousand dollars to restore those mighty machines. Both the city's newspapers and its scientific community have been helping Ms. Rossi since the power shortage last Christmas.

American Windmills, Past and Present

In the 1850s Daniel Holladay, a young mechanic in Connecticut, built a self-governing windmill. Little has been published about him except that he doubted that there would be much of a market for his invention. But his and other Americans' patents resulted in the development of a new type of windmill with many short sails rather than a few long ones. Factories throughout the country produced and sold millions of those machines in the next half-century. Wealthy men bought them to have running water in their homes. The Union Pacific used them to fill trackside tanks with water for the first locomotives that chugged across the continent. And cattlemen and homesteaders bought them to turn the great American plains into the source of much of our food today. Rural electrification in the 1930s doomed all but a couple of the factories that produced those windmills.

Palmer Putnam, a Boston engineer, designed the only windmill that ever fed significant amounts of energy from the wind into a modern utility network. It was built during World War II on Grandpa's Knob, a hilltop near Rutland, Vt., with the help of distinguished meteorologists and engineers from M.I.T. and other schools and major companies like General Electric. Though the wind soon tore off one of the windmill's long arms, Vannevar Bush, then President of the Carnegie Institution, hailed the project as a success; and Putnam's book about it, *Power From the Wind*, is still one of the best textbooks available on the windmill builder's problems.

For everyone who enjoys seeing a big ingenuous machine, it is unfortunate that Putnam's plant was junked. Nothing comparable to it has yet been built or seems likely to be constructed soon. Thanks to the preservation movement that the Jamestown ladies started, however, you can still see and hear post and smock mills grinding corn into meal the way that it was done centuries ago. Colonial windmills have been treasured in several states and I have especially enjoyed visiting some of them in Virginia, Rhode Island, and Massachusetts.

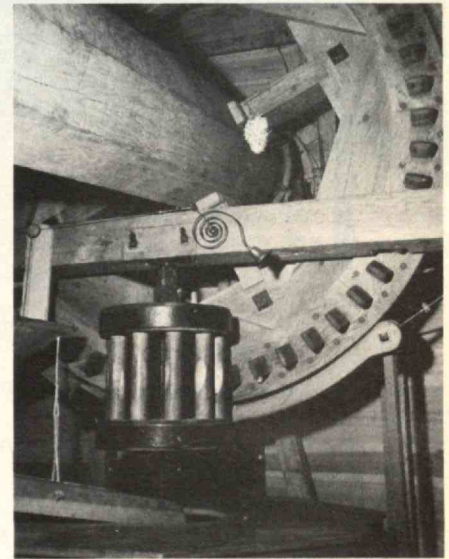
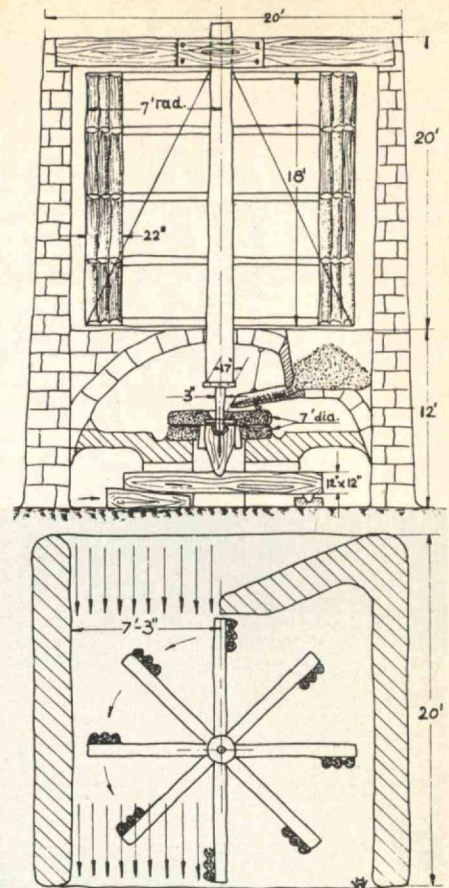
The post mill reconstructed a few years ago in the restored section of Williamsburg, Va., is one of the most conspicuous attractions for tourists there. It groans and sighs whenever the wind awakens it, and the meal from between the heavy stones spurts into a trough where the miller feels it with his hand to judge its quality. He will also gladly show you how he can turn this whole mill in whatever direction he wishes with a long tailpole and how he spreads or furls the canvas on the lattice work on its long arms.

Near Newport, R. I., a restoration society started by Jackie Onassis and Doris Duke, the tobacco heiress, recently restored a huge English smock mill in an idyllic setting. It has two sets of millstones and its interior is a novel work of art. There you can see both how the mill was built originally and what had to be done to meet modern sanitation requirements. This mill roars and vibrates so much when running at top speed that the miller does not dare admit visitors lest they be injured. He is a husky, enthusiastic chap who not only taught himself to run this windmill for Ms. Duke but is also breeding corn back to the kind of seed that the Indians gave to the first colonists in Rhode Island.

A third windmill well worth visiting is one restored for the Heritage Plantation at Sandwich on Cape Cod. It is a typical small smock mill that has been altered for tourists' edification. A hidden electric motor enables the miller to keep it going when the wind is not blowing, and you need only step into the doorway to see the whole works in action. There you can look up at big wooden gears turning in the windmill's cap and at the same time smell the corn meal fresh from the furrows in its granite millstones. The miller at Sandwich has read a great deal about the origin and development of windmills and can instantly answer almost any question that may occur to you.

Join the International Molinological Society

At both Williamsburg and Newport you can buy little sacks of the meal ground by the wind's power to take home and try.



The first windmills of which much is known were built in Persia (top), and mills of the same type remain in use today. The wind vanes, bundles of reeds, are mounted on spokes tied to a vertical shaft (plan view, below); the shaft (cutaway, above) penetrates the roof of the mill house. Early American windmill design was similarly elegant. The photograph shows the wooden gears of the Robertson Mill in Colonial Williamsburg; here the rotation of the horizontal main shaft is converted into the movement of the vertical shaft which performs the miller's work. (Drawing from Hans E. Wulff, *The Traditional Crafts of Persia*, M.I.T. Press, 1966; photo from Colonial Williamsburg Foundation)

The windmill, once the landmark of every American farm, is making a comeback. The New Mexico State University College of Agriculture thinks there are 175,000 water-pumping windmills left on U.S. farms and ranches, and half of them may be in good working order or readily repairable. Morgens Rasmussen, who wrote the New Mexico study, told the *Christian Science Monitor* that "there is a rapidly growing demand for the old-fashioned pumpers" throughout the farm belt, and two major windmill companies left in the U.S. simply cannot keep ahead of demand. (Photo: Daniel S. Brody from Stock, Boston)



Even a brief visit to either place is likely to increase your interest in our country's technological history. You may then want to join one or more of the organizations that are helping today to preserve old windmills.

The most prestigious of them all is the International Molinological Society (T.I.M.S.). It was founded in 1962 in Denmark, the country in which the wind's energy was first used extensively to generate electricity. T.I.M.S. members are predominantly scholars interested in the development of food processing technology. They meet in a different country every fourth year to present detailed reports on their research. The secretary is a British architect, J. Kenneth Major, and the published proceedings of T.I.M.S. meetings are beautifully illustrated, fascinating additions to technical literature.

In the United States, the Society for Industrial Archeology was organized in

1971 at the suggestion of the director of the Old Slater Mill Museum in Rhode Island. Robert E. Vogel, the Smithsonian Institution's Curator of Mechanical and Civil Engineering, edits a newsletter, one of whose chief aims is to alert the Society's members to threats to historic structures. Vance Packard (the popular writer's son), who is associated with the William Penn Museum in Harrisburg, Pa., is the Society's secretary, and it arranges for its members tours of interesting old factories, depots, bridges, mills, etc.

If you are especially interested in flour mills, you should certainly also subscribe to *Old Mill News*, published by the Society for the Preservation of Old Mills, organized in Maine in 1972. This group's Secretary is Everett S. Powers of Glenside, Pa., and its publication is exactly what its name promises.

There are also smaller groups of windmill buffs in many states. One of the newest

and most lively, at Gibbon, Neb., is collecting and restoring various examples of American farm windmills for an outdoor museum near the interstate highway across the state. The Gibbon Chamber of Commerce started it, calling it a new W.P.A. (Windmill Preservation Association); and its secretary, D. E. McGregor, sends members certificates stating that they are P.O.W.s (Preservers of Windmills).

These and dozens of other societies will see to it that all of us are reminded of our nation's technological progress as well as its social and political innovations during the celebration of its bicentennial.

Volta W. Torrey, who formerly edited Technology Review, is now a member of N.A.S.A.'s technology utilization program; he is writing a book on windmills.

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Bringing Science to the Congress

Washington Report
by
Arthur H. Purcell

The lack of technical expertise in the U.S. Congress was exposed more clearly than ever before during debates on the A.B.M. and the supersonic transport early in this decade. The inability of outside scientific "experts" of all political stripes and technical persuasions to agree on these complex issues made legislators more conscious than ever before of their need to understand better the technical implications of Congressional decisions.

Now the technological challenges facing the legislative branch are greater than ever — energy, environment, health care, mass transit, housing, and nuclear armaments are examples of pressing national problems to the consideration of which there must be significant scientific and technological inputs. What has been done since the A.B.M. and S.S.T. to provide sound and credible technical staff capability to deal with them?

One promising development has been the creation of the Office of Technology Assessment, established to aid the legislative branch in technological matters. Another has been the strengthening of the scientific capabilities of the Congressional Research Service in the Library of Con-

gress. A third takes the form of recommendations of the House Select Committee on Committees to streamline and enhance technically-oriented committees of the House of Representatives. These achievements represent longer-term and somewhat indirect approaches to solving Congress' scientific manpower problems. A more direct plan with immediate results — placing several doctoral-level scientists and engineers on Congressional staffs through Congressional science and engineering fellowship programs — is now coming of age.

Fellowship and intern programs *per se* are nothing new to Congress; but the year-long fellowship programs of four professional science and engineering societies represent new and significant steps to bring scientific and technological expertise into the federal legislative process. The American Society of Mechanical Engineers, American Association for the Advancement of Science, American Physical Society, and the Institute of Electrical and Electronic Engineers have placed 19 such full-time fellows on key Congressional staffs since early in 1973. The experiences of these young men and women on Capitol Hill have prompted four of the first seven (currently 12 Fellows are halfway through the 1974-75 program) to remain in Washington beyond their terms, and the other three are committed to continuing part-time interaction with the staffs and offices they have served so well. This success represents a quantum leap in the potential for technology and politics — usually considered immiscible — to intermix successfully.

The largest of these fellowship programs, that of the A.A.A.S., began with a proposal made at a 1972 A.A.A.S. Science and Society Committee meeting: Could the Committee develop a plan to help younger scientists and engineers devote a year's full-time efforts to technical problem-solving in the U.S. Congress? At that time there were probably less than a half dozen Congressional staff members — out of several thousand — who could claim training or expertise in science or engineering and an even smaller number

of senators and representatives with such credentials.

Like most committee proposals, this one took some time to flourish; but by April, 1973, A.A.A.S. had secured funding (a combination of in-house and private donor money) for three fellows and staff support for a formal Congressional Scientist-Fellow Program.

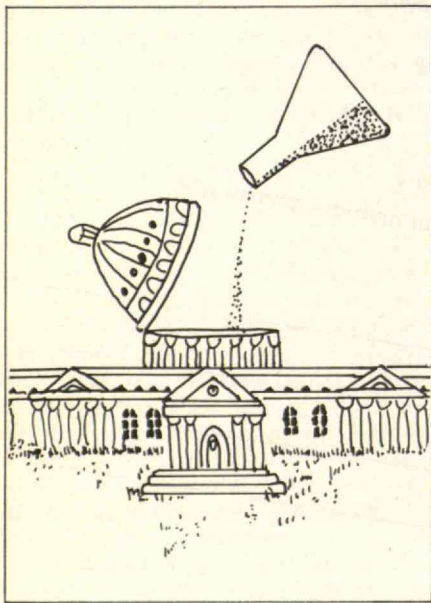
In the meantime, A.S.M.E., on a more modest scale, had selected and placed the first Congressional engineering fellow on the Senate Commerce Committee staff; he was Barry Hyman, a member of the mechanical engineering faculty at George Washington University on sabbatical leave.

Within six weeks after the announcement of the A.A.A.S. program, over 90 qualified scientists (social as well as natural scientists), engineers, mathematicians, and even statisticians had applied. They ranged in age from under 25 to over 50, and the \$12,000 stipend offered by the fellowships would have meant financial sacrifice to many of them.

Congress responded with equal enthusiasm. Just as Rep. Mike McCormack had predicted in a speech at the 1972 A.A.A.S. annual meeting, when he proposed that there were "some 50 to 100 places" in Congress where young, socially committed scientists could be used effectively, close to 100 senators, representatives, and Congressional committees requested services of a scientist-fellow. (One of the most interested members of Congress was then-Representative Gerald Ford.)

The "Old Pals" Meet the New Scientists

The first three A.A.A.S. Congressional Scientist-Fellows were chosen in June, 1973: Michael Telson, a recent Ph.D. graduate in electrical engineering from M.I.T.; Jessica Tuchman, who was completing Ph.D. studies in biophysics at California Institute of Technology; and Elliot Segal, Assistant Dean of the Yale Medical School. Three fellows from other societies subsequently joined the program: Benjamin Cooper, Assistant Professor of Physics at Iowa State University, *Continued on p. 68*



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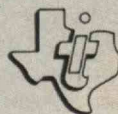
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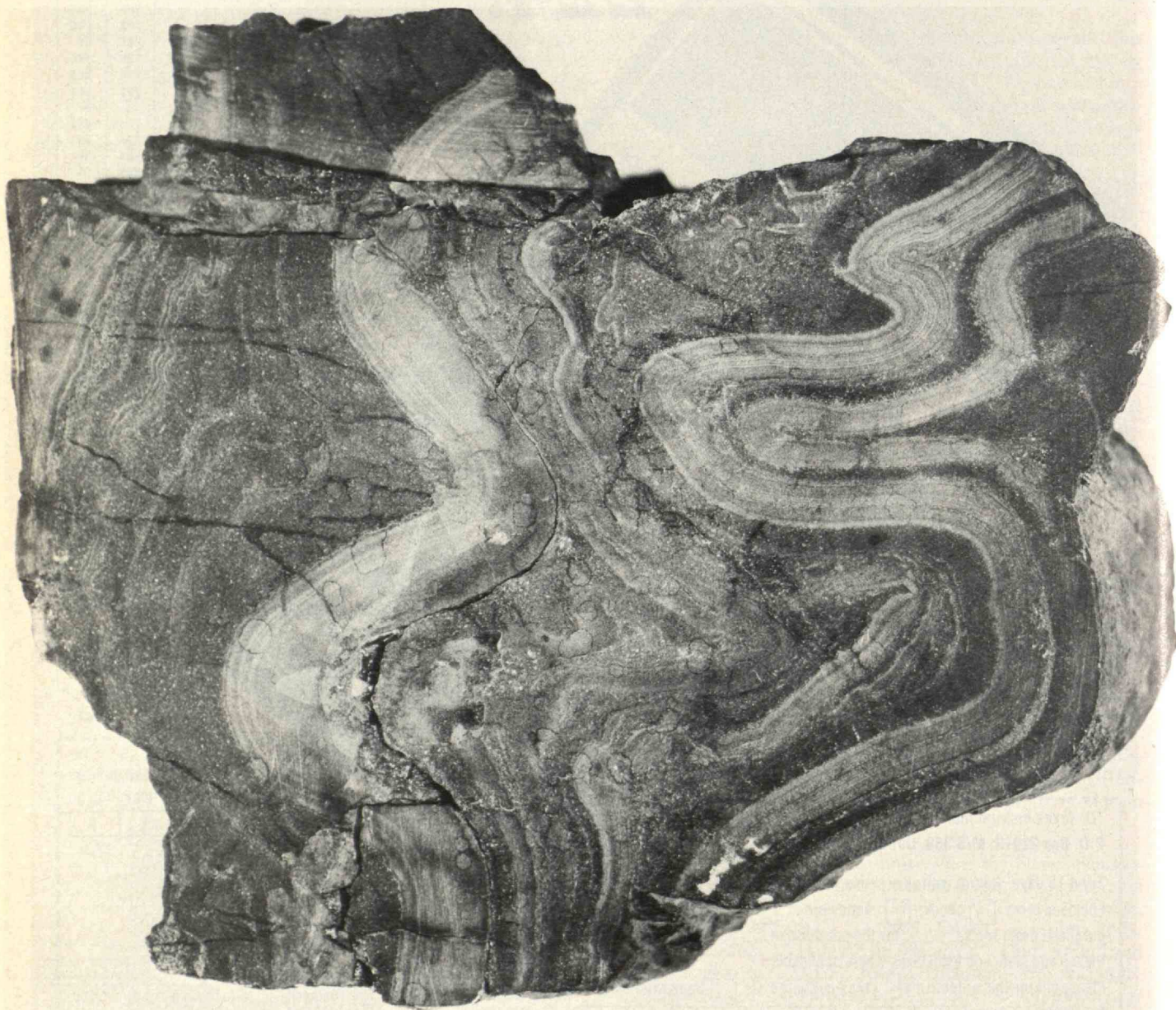
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The theory of moving crustal plates has unified our understanding of the earth's geological processes. It may now give us a unified view of the origin of metal-rich provinces.



Ore from the Sullivan Mine in Kimberley, British Columbia. It consists of finely alternating bands of galena (lead sulfide) and sphalerite (zinc sulfide). The bands are contorted like toothpaste squeezed from the tube, and are traceable, if straightened out, for distances of kilometers. Evidently they were deposited on a seabed and deformed while still soft as a mud.

Plate Tectonics and Mineral Deposits

Theories of the origin of mineral deposits have been important since the earliest days of geology. As in most branches of science, fractionalization of ideas occurred as a result of seeing different parts of the whole picture, and it is with a rude shock that some of the unifying ideas to be described below have begun to appear in the literature. Correct or not, the new ideas have sweeping implications for understanding not only the origin of mineral deposits throughout geologic history, but also plate tectonic mechanisms extending back into the earliest known crustal systems.

Plate Mechanisms and Mineral Provinces

The theory of plate tectonics involves the motion of rigid crustal plates on the earth's surface. The larger plates maintain coherence over such great areas that only about eight of them account for most of the planet's surface. An oceanic plate is a cooled rigid mass with a mean density greater than that of the heated and weakened substratum beneath it, which consists of approximately the same material. Because the earth's interior loses more heat than is lost by conduction alone through a surface plate, the substratum heats up, and its viscosity decreases to a point where, in regions called subduction zones, the overlying plate slides off in a sloping plunge. This event opens up a rift at the other side of the plate which brings the hot substratum material to the surface along a belt known as a spreading ridge. Continental masses impede this process, and are carried about by the moving plates, with much collision, splitting, and reassembly. The continental crustal regions are buoyant enough not to sink and have grown in size throughout geological time as the earth undergoes a chemical separation of components that do not form stable compounds at the temperatures of the interior. The continentals therefore contain the record of the past, whereas the ocean basins are transient and constantly renewed. A piece of oceanic plate can survive only if it is incorporated into a larger mass of continent which buoys it up.

The sketch in Figure 1 shows the principal mechanisms whereby crustal plates are formed and destroyed. Points of particular interest in the study of mineral deposits are: (1) the spreading ridge, where new plates are being formed; (2) the island arc subduction zone, where a plunging ocean plate builds up a pile of volcanic materials, as in the western Pacific islands; (3) the marginal basin that frequently forms between an island arc and the adjacent block of continent, such as the Japan Sea; and (4) the subduction zone where a continental plate margin

is underlain by a plunging oceanic plate, as in the Andean Belt of South America. Three other regions of possible importance are: (1) the suture zone between colliding continental blocks, such as the Tibetan Plateau; (2) the intracontinental belt of incipient subduction or overthrusting, such as the Colorado Plateau; and (3) regions where mantle upwelling may have occurred beneath a continent, as suggested for some of the so-called Pan-African mobile belts.

The spreading ridge develops a characteristic rock cross-section in the oceanic plate, but it may subsequently become sandwiched into a complex of island arc volcanics and basin sediments as it moves into a subduction region. Therefore it is necessary to work with particular rock associations in order to interpret the point of origin of a mineral deposit. We shall use the term "ultramafic" to denote a silicate rock rich in magnesium and iron that is characteristic of the earth's upper mantle (the substratum beneath the plates), as well as the bulk of an oceanic plate beneath a thin cover of other rocks. This cover is made up of "mafic" or basaltic volcanic rocks, which are chemical extracts from the ultramafic rocks, and are richer in silica, alumina, and other lower melting fractions. The combination of ultramafic rocks and submarine mafic volcanics, together with a set of rifted fractures or "dikes" filled with the solidified volcanic magmas as they separated from the ultramafic material, and also with a cover of specific types of deep-ocean sediments, provides a highly diagnostic association which indicates a spreading-ridge section. This assemblage is seen today mixed in with island arc volcanics and other assemblages, after parts of the oceanic plate have been caught up rather than subducted, but it can be recognized by its unique rock types. The island-arc volcanics do not themselves include ultramafics. They are richer in silica, alumina, alkalis, and calcium oxide. We shall refer to these island arc products as being "intermediate to acidic" volcanics in order not to involve ourselves with the lengthy and subtle differences in the compositions of the less mafic volcanics.

The types of mineral deposits associated with these plate boundary mechanisms are rapidly being elucidated by studies which begin with the clearer cases of recently formed deposits, and then proceed backward in time to the more altered and obscure cases. First let us see if we can predict possible concentrations of ore minerals on a geochemical basis; then look for a simple, unquestionable example to demonstrate the validity of the mechanism. We can try this for the first three major plate mechanisms.

Figure 1. A cross-section of the earth's upper mantle and crust shows, in schematic form, the plate tectonic mechanisms of principal interest in the study of mineral deposits. At the right of the drawing is a mid-ocean ridge, where molten material rises and divides into two plates, one of which moves toward the left, carrying a continent with it. The plate sinks in a subduction zone at the left, but in doing so, it releases magmas that rise to the surface, feeding the volcanoes of an island arc. At the extreme left is a marginal basin, such as the Sea of Japan, which lies between an island arc and a continental mass.

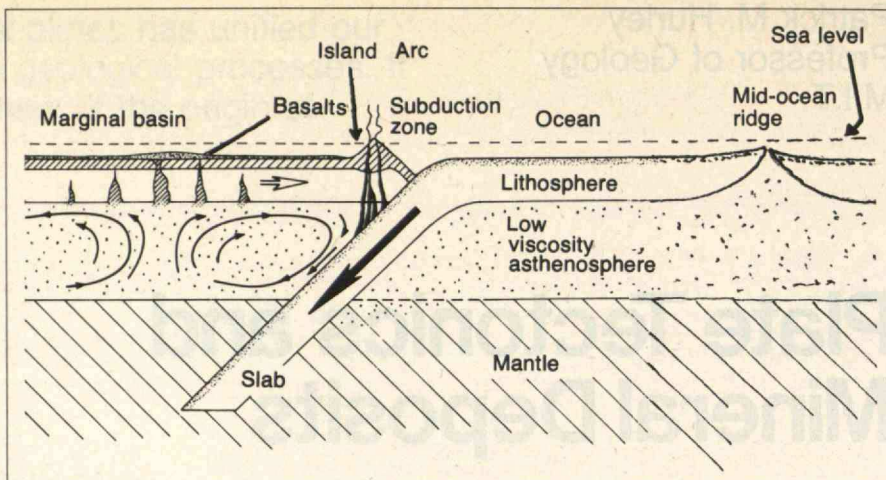
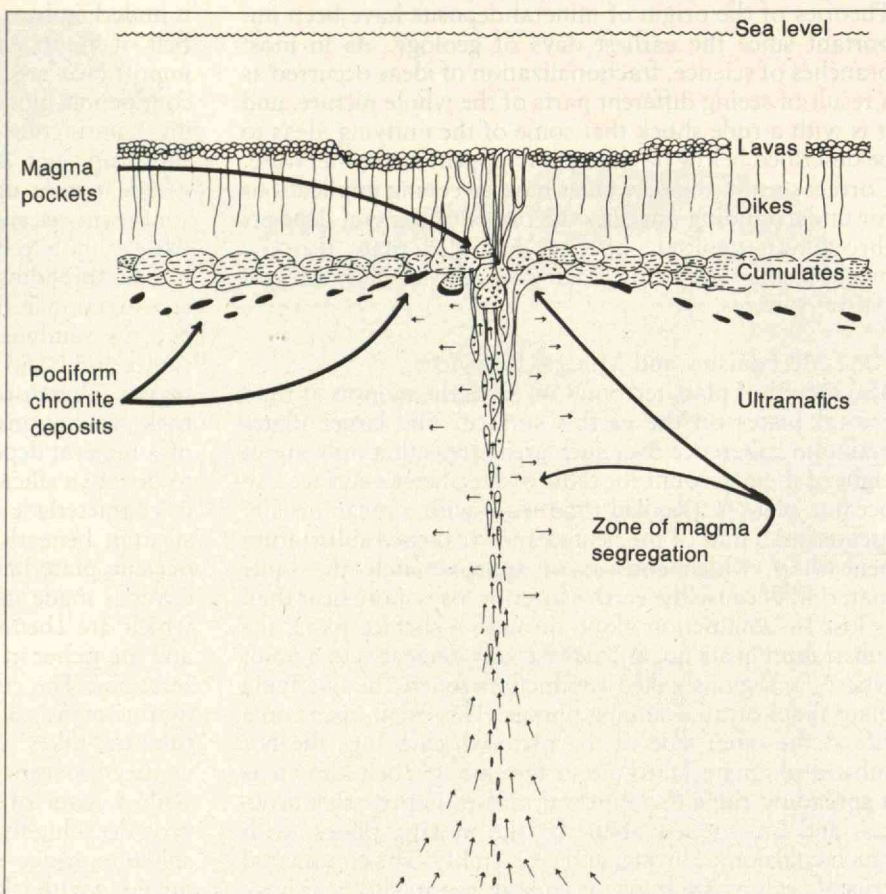


Figure 2. A cross-section of a mid-ocean ridge (after Dickey) shows the creation of two plates, one moving toward the left, the other toward the right. At the top of each plate is a layer of oceanic sediments. Below that is a zone of lavas, then a zone of dikes, and finally a layer of ultramafics — rocks characteristic of the upper mantle. Within the upper levels of the ultramafics are masses of chromium ore.



1. Accreting Plate Margins

A construction of the igneous processes and possible mineral constructions that may take place in a spreading ridge is illustrated in Figure 2, provided by John Dickey of M.I.T. Basaltic magma separates upward in a column from the ultramafic material of the earth's mantle, which in turn spreads laterally to form the base of the oceanic plates. The basaltic material reaches the surface in a set of sheeted dikes and then flows over the surface beneath the water in a series of "pillow lavas" — accumulations of discrete volumes of lava that have been surrounded by steam. The result is a vertical column: At the top is an oceanic sediment containing red ochreous material, silica, and often manganese; below this a thickness of pillow lavas, then a region of sheeted dikes, and finally ultramafic material. This characteristic cross-section moves laterally, forming the base of the ocean floor.

From general knowledge, geologists would predict that masses of chromium ore would separate within the upper ultramafic region, close to the level of the dikes. These layered segregations would become broken and sheared as the hot ultramafic rock started to move away from the spreading center. The result would be broken masses of chromium ore, often called "pods," within the particular type of ultramafic rock from which they segregate.

Other mineralizations could occur elsewhere in the column: There might be times when iron, copper, and nickel sulfides would separate within the base of the basaltic column. Circulating seawater and exhalations of water from the magmas themselves might deposit sulfides of iron, copper, and minor zinc within the masses of accumulating pillow lavas; and iron and manganese could be precipitated with silica out of seawater solutions into the overlying sediments and volcanic materials, with

other metals also present, though in lesser abundances. Finally, if the mid-oceanic section of upper seafloor crust were thrust up onto a continental surface at any time, nickel deposits could form by weathering of the ultramafic rock, which is fairly rich in nickel, and metamorphic and hydrothermal activity could form asbestos deposits within the ultramafic rock. Thus we see that there is potentially a broad array of important mineral occurrences which may have formed at a spreading ridge, or later in the same rocks, after they have been brought up onto a continent.

Can a single well-documented example of an array of ore deposits with this geological association be found? The answer is yes — the Troodos area in Cyprus, and its group of mineral deposits, is an excellent example. Figure 3 shows schematically one of several large copper sulfide deposits near the top of a section of pillow lavas, sheeted dikes, and underlying ultramafics. Several tens of millions of tons of high-grade copper ore have been exploited. The deposits have detailed characteristics indicating that they were formed at the same time as the volcanic flows, and thus before the deposition of the overlying sediment, which includes an umber-like material consisting of iron and manganese oxides. In the ultramafic rocks below the lavas there are workable deposits of chromium ore. Moreover, the ultramafics contain important chrysotile asbestos deposits, particularly where there has been shearing.

This example is so complete and convincing that many geologists today believe that many of the copper sulfide deposits of the world, associated with mafic pillow lavas but not with intermediate or acidic volcanics may well have been formed in oceanic spreading centers and transported in oceanic plates to positions where they are caught up in a continental mass. They are now referred to as the Cyprus type. Pods of chromium ore that occur rather closely below the sheeted-dike section in the oceanic plate are similarly transported and appear where oceanic ultramafic rocks have been elevated into an island arc or other site involving overthrusting.

It is easy to make mistakes, however. Let us consider eastern Cuba as an example of an uplifted section of seafloor. The Nipe Highlands represent an ultramafic mass underlying the thick section of Cobre volcanics, including pillow lavas, of the Sierra Maestra. Blocks of chromium ore occur within the ultramafic rock, and in fact much of our chromium during the Second World War came from this region. A rule in prospecting was always to keep within a few hundred yards of the overlying gabbro dikes and volcanics. Near the top of the Cobre volcanics we find the El Cobre copper mine and similar deposits. Above the Cobre volcanics are manganese deposits that clearly developed at the interface between the volcanics and the overlying sediments. They were deposited in water with siliceous material, largely as a hydrated manganese oxide — the mineral psilomelane — which upon dehydration shows characteristic columnar shrinkage cracks. The ore is accompanied by umber-like sediments, sharks' teeth surrounded by manganese, and other features showing that the mineralization was synchronous with the first sediments. Thus we seem to have the entire sequence. However, on close inspection the volcanics and sediments are not quite right for a spreading ridge, and farther to the east we find a magnetite iron deposit associated with an acidic intrusive rock. It turns out that the ultramafic mass and its associated chromium

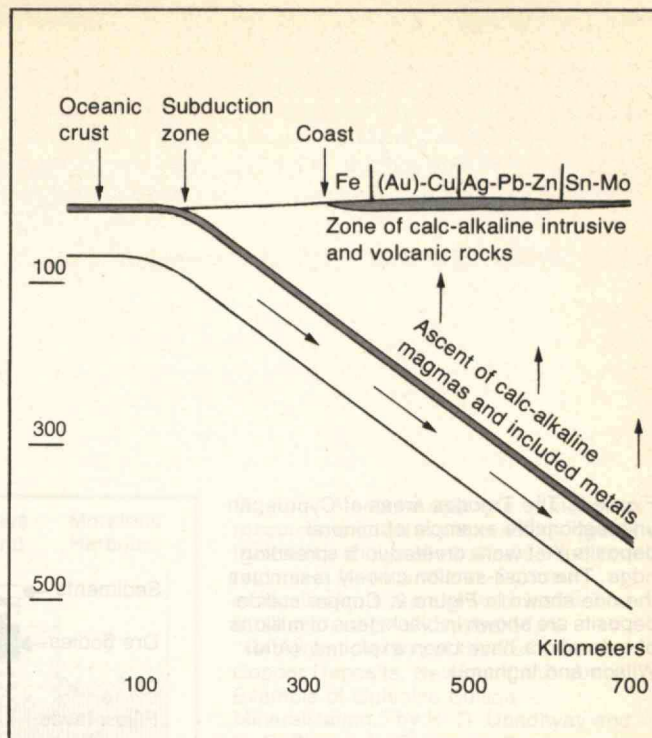


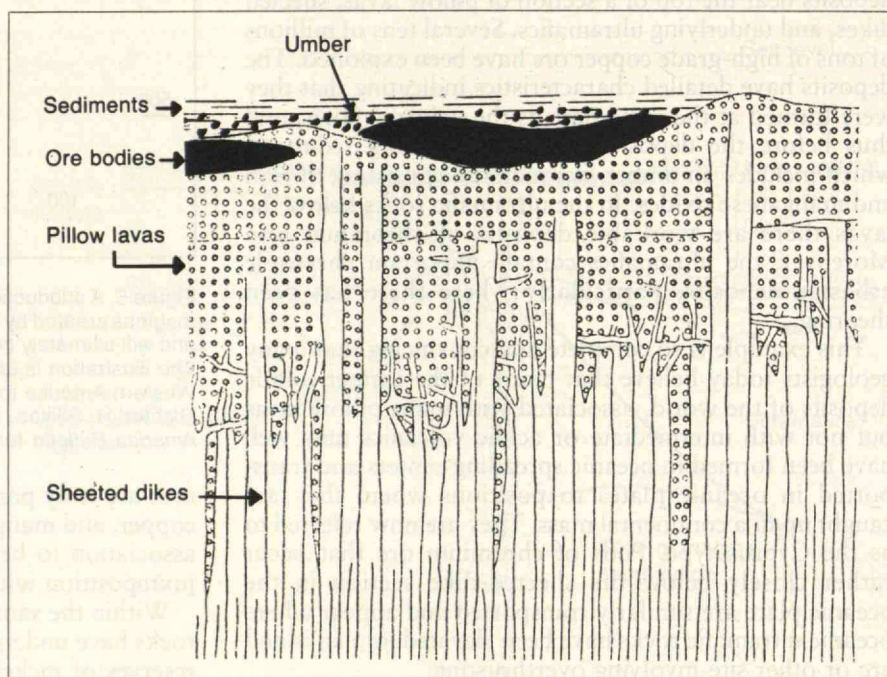
Figure 5. A subduction zone is shown in cross-section. At the right, magmas created by the sinking plate are rising toward the surface, and will ultimately create mineral deposits like those in the Andes. The illustration is taken from "Relation of Metal Provinces in Western America to Subduction of Oceanic Lithosphere," by Richard H. Sillitoe. It appeared in the *Geological Society of America Bulletin* for March 1972.

ores are truly part of an oceanic plate, but the volcanics, copper, and manganese were probably part of an arc type association to be described below, and were thrust into juxtaposition with the Nipe seafloor block.

Within the same region of eastern Cuba, the ultramafic rocks have undergone deep weathering, leaving very large reserves of nickel and iron ore in residual soils. Similar residual deposits of nickel are found in many other equatorial island-arc regions, and altogether constitute the largest known usable reserves of nickel in the world. Although developed later, these ores owe their existence to blocks of oceanic plate that escaped subduction.

Turning now to a continental area where the mineral deposits have previously been without an explanation, we find excellent examples of spreading-ridge type deposits within the northeastern United States and the Maritime Provinces of Canada. A schematic composite diagram (Figure 4, after Upadhyay and Strong) shows that the copper deposits in Newfoundland, shown in black, have all the correct characteristics: The ultramafics are overlain by sheeted dikes, which are overlain in turn by pillow lavas and ores, and finally by ochreous and other sediments. Furthermore, there is a great center of asbestos production in southeastern Quebec, lying in the belt of ultramafics. Also within the belt are chromium deposits in the Black Lake region of Quebec, and copper deposits in the pillow lavas extending into New England. In these cases, the presence of the ore deposits themselves are part of the argument in favor of an inward moving oceanic plate in the Paleozoic, several hundred million years ago. In the worldwide distribution there are numerous other examples, of all ages, even extending back into the Archean, the time of the earliest crust.

Figure 3. The Troodos areas of Cyprus, an unquestionable example of mineral deposits that were created in a spreading ridge. The cross-section closely resembles the one shown in Figure 2. Copper sulfide deposits are shown in black; tens of millions of tons of ore have been exploited. (After Wilson and Ingham.)



2. Andean Type Subduction Zone

The second major association of mineral deposits with plate boundaries is referred to as the Andean type. Figure 5 shows a down-going oceanic plate moving beneath the edge of a continent, and ultimately creating deposits typical of the Andean belt in South America. The process is as follows: Uprising magmas, presumably generated at the top of the down-going slab, penetrate the edge of the continent, sometimes reaching the surface with extrusive lavas. These pipe-like stocks tend to have a zonation of mineralization in their upper parts which accounts for most of the copper production in the world, most of the molybdenum, and in certain restricted regions almost all of the tin and tungsten. These are not restricted to continental plate edges alone, but may also occur in well-established thick island-arc volcanic piles. These giant copper deposits took on the name "porphyry coppers" when early workers mistakenly called the intrusive rock a porphyry.

The distribution of porphyry copper deposits in the Western Hemisphere is shown in Figure 6 (after Lowell). It follows the locus of down-going oceanic plates plunging beneath the western edges of North and South America at the time the deposits were being formed. The association of porphyry coppers with subduction zones is

so evident that prospecting has relied on this fact, and a number of new major deposits have been found in regions that would never have been prospected before. Examples are in East Asia, Iran, Puerto Rico, and British Columbia. The array of igneous intrusives and mineral deposits forming these vast and heretofore unexplained metallogenic provinces are now clearly seen to be the result of subducting plates. In fact, the hundreds of deposits of copper, tin, molybdenum, tungsten, antimony, gold, silver, mercury, and manganese along the east coast of Asia have an age grouping which relates to the depth and penetration of the down-going plates in that region.

Porphyry copper deposits also occur along the north-east U.S. coast, but they are lower grade, and are now seen as *deeper* equivalents owing to the greater depth of exposure by erosion. The depth zonation in porphyry copper deposits runs from higher copper content near the top of the stock to lower grade deposits or other types of mineralization at greater depth. Figure 7, by Hollister and others, shows the lower parts of porphyry copper and molybdenum deposits in New England and the Maritime Provinces. We would never have suspected any such origin for this metallogenic province had it not been for extrapolation from the younger, clearer case just described.

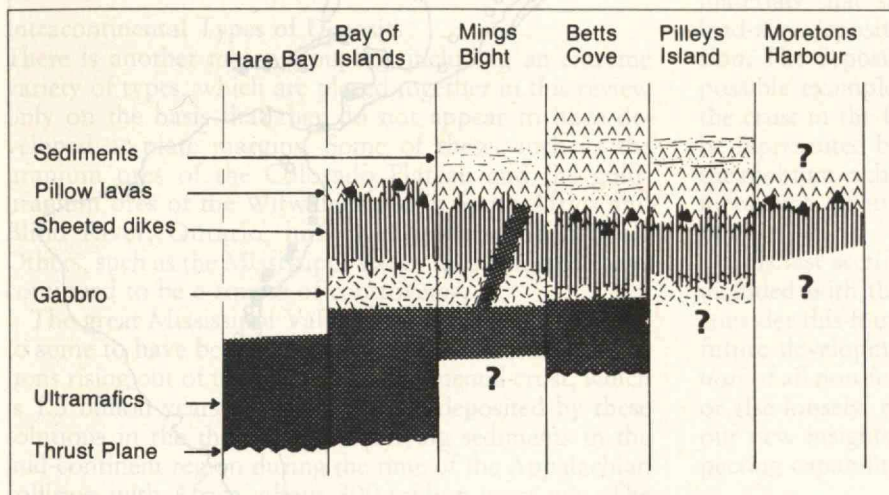


Figure 4. A second example of mineral resources created in a spreading ridge. The illustration shows several cross-sections of regions in Newfoundland. Sulfide mineralizations are shown in black. The illustration originally appeared in "Geological Setting of the Betts Cove Copper Deposits, Newfoundland: An Example of Ophiolite Sulfide Mineralization," by H. D. Upadhyay and D. F. Strong, in *Economic Geology*, March-April, 1973.

3. Island Arc Subduction Zone

We now come to the third association, or genetic type, found in island-arc volcanism, and shown in Figure 8. This is a large group of mineral deposits which are not associated with igneous bodies that have intruded into an older continental plate, like the Andean type, but instead are associated with mafic to acidic volcanics that have vented beneath the sea in the general region of an arc. These deposits form within sediments on the seafloor while the sediments are being deposited. The group has been one of the most enigmatic and unexplained, because it has representatives in cases of all ages and metamorphic conditions where much of the evidence of origin has been obliterated.

The breakthrough in interpretation came suddenly with a study of island-arc volcanism and mineral deposits in Japan, where it was first demonstrated that a submarine volcanic exhalative origin applied to certain base metal deposits, now known as the Kuroko type. Just as the Cyprus deposit represents a spreading ridge, the Kuroko type of deposit is the key example showing how the development of acidic volcanics in an island arc above a downgoing subduction plate can give rise to large bodies of copper-lead-zinc sulfides by deposition in a marine environment adjacent to the volcanic vent. These deposits are always associated with intermediate to acidic volcanics and their outbursts of fragmental materials, and this association is used as an identifying characteristic. The deposits are quickly covered by sediments and additional volcanics which may be pillow lavas, and may be

subsequently thrust into a continental site and preserved since the earliest history of the earth.

Actually the island-arc association is much more complicated than this description suggests, and ranges from earlier "Besshi-type" copper deposits in more mafic environments through a variety of other submarine exhalative types, of which the Kuroko deposit is a representative, to actual porphyry copper deposits associated with late igneous intrusive stocks.

Extrapolating from these kinds of deposits into the more distant past, we find very probable explanations for many enigmatic deposits of major size. The Sullivan mine in British Columbia has been the largest lead-zinc producer in the world, for a single deposit. The ore (illustration on p. 14) clearly formed with the associated sediments, and has been greatly deformed while still soft as a mud. The deposit is close to intermediate and acidic igneous rocks and is surrounded by quartzitic sediments. Siliceous material is also interbedded in the ore and may represent in part an outpouring of silica-bearing solutions from the volcanic vents.

Extending the extrapolations even further into the past, we may consider a similar origin for many of the other massive sulfide deposits of the world. The ores range from iron sulfides with copper as the principal economic metal, to types in which combinations of gold, zinc, lead, and silver become the important constituents. Generally the more acidic the associated volcanics, the more the ores tend toward increases in lead and silver. As detailed by Hutchinson, examples of the copper-zinc type are the

Figure 6. A map of North and South America shows the major porphyry deposits of copper and molybdenum. Their distribution traces the locus of subduction zones. The illustration is taken from "Regional Characteristics of Porphyry Copper Deposits of the Southwest," by J. David Lowell, *Economic Geology*, August 1974.

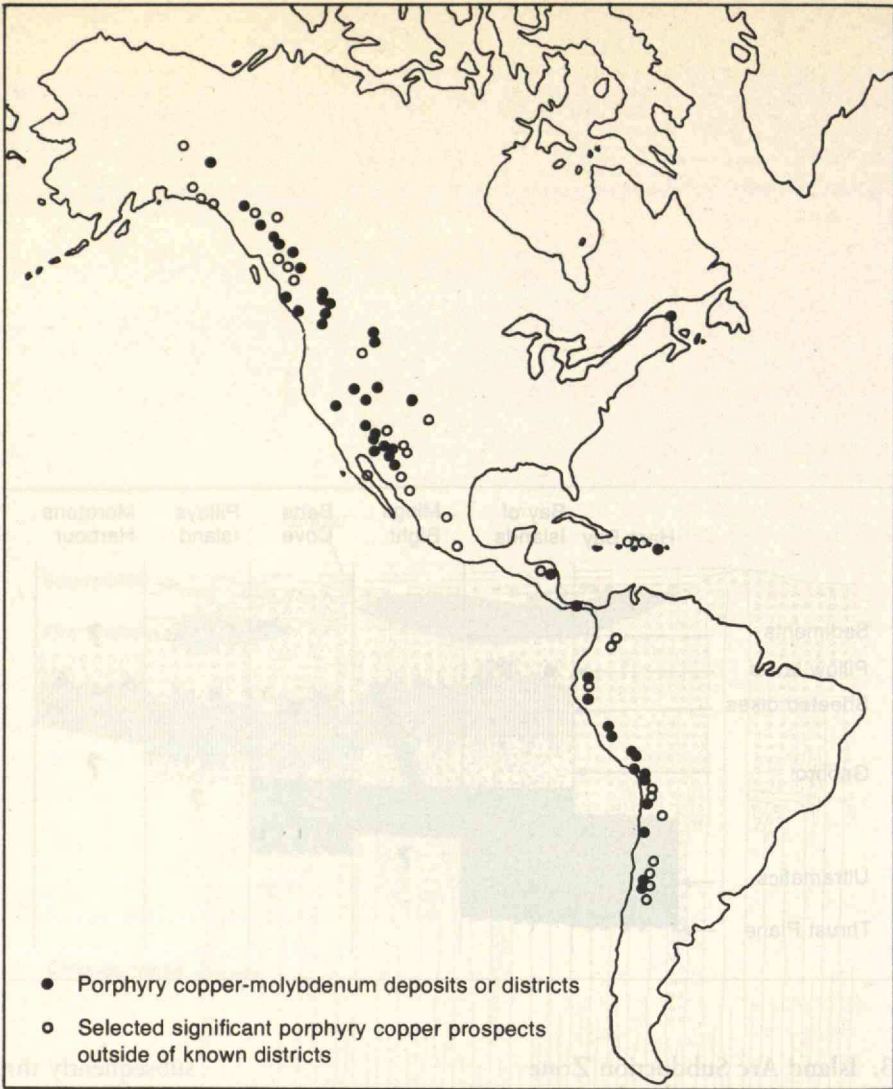


Figure 7. Deposits of copper and molybdenum in New England and the Maritime Provinces, probably representing the now-exposed parts beneath eroded porphyry-type deposits. By extrapolating from clearer cases, these deposits are now seen to have been created above a subduction zone. The illustration is modified from one that appeared in "Porphyry-Type Deposits in the Appalachian Orogen," by V. F. Hollister, R. R. Potter, and A. L. Barker, in the August, 1974 issue of *Economic Geology*.

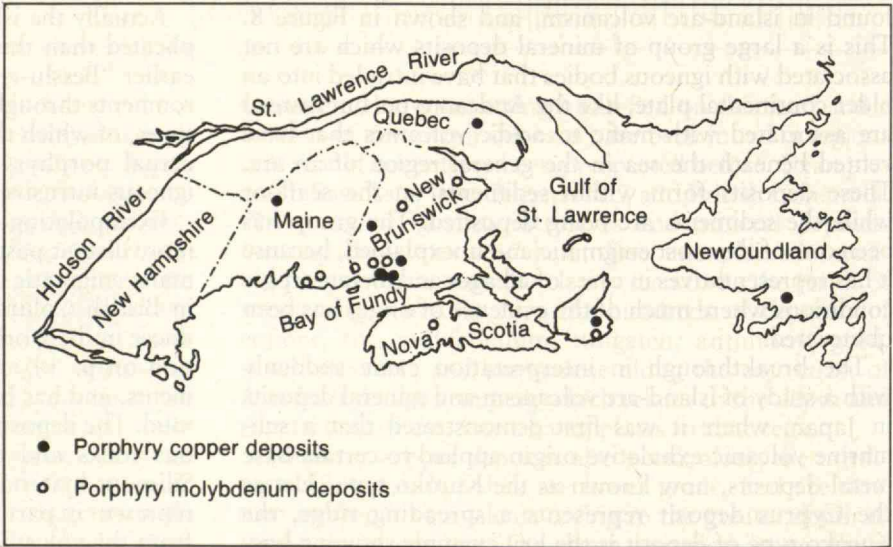
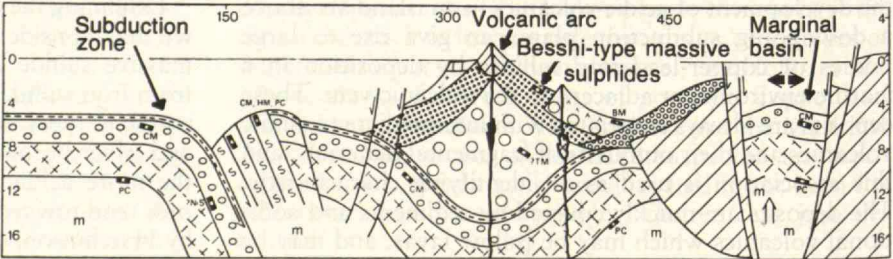


Figure 8. A demonstration of the complexity of island arcs. In this drawing, the arc is shown 15 million years after its evolution has begun. The volcanism has reached sea level and sulfide deposits have been created on its flanks. At the right, a marginal basin is being created between the island arc and a continent. At the left is the subduction zone associated with the volcanism. The illustration first appeared in "Island-Arc Evolution and Related Mineral Deposits," by Andrew H. Mitchell and J. D. Bell, in *The Journal of Geology*, July 1973.



Archean Noranda, Amulet, and Mattagami deposits of Quebec; the Proterozoic Flin Flon and Snow Lake deposits of Manitoba; and the deposits of the Mesozoic Shasta District, California. Types richer in lead are exemplified by the Broken Hill and Mt. Isa deposits of Australia; the Bathurst District of New Brunswick; and the base-metal deposits of Tasmania. The igneous rock associations of these ores are characteristic. Thus it seems that most of the massive sulfide deposits of the world, of all ages, may now be seen as either spreading-ridge type or island-arc type, depending on the absence or presence of ultramafics, the more acidic volcanic association, and other details of sedimentary and explosive volcanic record. There is no reason to doubt the existence, and even the increase, of oceanic plate activity extending backward into the distant past.

Intracontinental Types of Deposits

There is another major grouping, including an extreme variety of types, which are placed together in this review only on the basis that they do not appear to have developed at plate margins. Some of these, such as the uranium ores of the Colorado Plateau and the gold-uranium ores of the Witwatersrand in South Africa and Blind River, Ontario, have well-understood origins. Others, such as the Mississippi Valley lead-zinc ores, have continued to be a source of controversy.

The great Mississippi Valley lead-zinc deposits appear to some to have been the result of hot mineralizing solutions rising out of the underlying continental crust, which is 1.3 billion years old. Metals were deposited by these solutions in the thin skin of overlying sediments in the mid-continent region during the time of the Appalachian collision with Africa, about 300 million years ago. The coincidences, first of a 1.3 billion year age for the lead isotopic relationships in the ores with the same age of the basement, and then of a 300 million year age of deposition of the ores with the same age of the bordering mountain-forming event, point to a remobilization of ores during a period of bordering compressional stress. What kind of underlying continental crustal rocks could have been involved?

The answer to this question can be best investigated in Africa, where 500-million-year-old "Pan-African" belts wrap themselves around and between older blocks of continental crusts. Most of the base-metal deposits in Africa occur in these belts. At the present time, the two prevalent hypotheses are that the belts formed either by closing oceans with subsequent collisions between the older blocks, or else by a ridge-type spreading or heating beneath a continuous older continental plate. My own preference is the latter hypothesis, because in the case of the Nigerian Pan-African belt the record of sedimentation to the north, in the Sahara region, shows that the belt was not undergoing collision at the time of its development. Instead the record shows nothing but extension and rifting, with deep sedimentary basins. Other evidence, particularly the great extent of the new material from the mantle, as indicated by low abundances of radiogenic strontium 87, also suggests a hot, upwelling mantle convection system beneath the belt. Reactivation of old material as well as introduction of new magmas probably account for the mineral deposits. The Nigerian belt extended along the coastal regions of southern Africa and Brazil before the opening of the South Atlantic and was active for 300 million years before the Atlantic rifting

started, exposing the nature of the hot upwelling, rather than downgoing or subduction, system involved.

Regions of hot material rising in the mantle beneath a continental crust could explain many features of intracontinental mineral deposits. In western North America, for example, the mineralization changes from dominantly copper to dominantly lead as one moves inland from a subduction region to a distance well beyond the limits of the subduction activity. In Africa, rifting with seafloor volcanism appears to have occurred in some of the Pan-African belts. If filled with sediments and volcanics and closed again, these could become metal-rich provinces like the copper belts of Zambia, Rhodesia, or Michigan. The Red Sea could be an example of such a rift, and the metalliferous brines found at its bottom during a deep-sea drilling project could represent source materials that subsequently developed Mississippi-type lead-zinc deposits, by upward migration under compression. The deposits in the Benué Trough in Nigeria are a possible example. If the hot mantle material penetrated the crust in the form of plumes, or "hot spots," it could be represented by the diamond-rich kimberlite pipes, or the niobium-rich carbonatite pipes; or indeed by the great metal-rich igneous outpourings of the Bushveld or Sudbury.

This last section is so speculative that it should not be included with the discussion of groups 1, 2, and 3. We consider this fourth group only to give an idea of possible future developments. It appears that the *major proportion* of all non-ferrous mineral deposits are either directly, or else loosely, related to processes of plate tectonics, so our new insights into metallogeny will extend our prospecting capability, so much needed in the years ahead.

Patrick M. Hurley received his B.A. from the University of British Columbia and his Ph.D. from M.I.T. He was appointed Assistant Professor at M.I.T. in 1946, and became Professor of Geology in 1953. Dr. Hurley is widely known for his research on geological applications of nuclear science, particularly in time measurements and isotope geochemistry. Recently he has been active in the study of continental drift and the development of continents.

Mineral Resources on the Ocean Floor

Ten years ago when M.I.T.'s Cecil and Ida Green Building was dedicated, the diagram shown at the top of page 24 appeared on the cover of the inauguration volume as a symbol of the power and beauty of nature. It is the Equatorial Undercurrent, a swiftly moving ribbon of water just below the surface that moves through the Pacific Ocean, west to east. The Equatorial Undercurrent produces four kinds of resources: protein for food; phosphate for fertilizer; kerogen, the precursor of petroleum; and possibly the valuable metal deposits on the adjacent seabed. The latter role of the undercurrent is indirect and complex, but all of these effects are essentially due to conversion of solar energy into chemical energy, and are part of the energy budget described by Vincent McKelvey in another article in this issue.

In the tropical ocean the sunlit, warm — and hence low-density — surface water is stably layered on the cold, dense, deep water. The deep water is rich in nutrients, but it cannot support any plant life since sunlight does not penetrate it. Nutrients in the surface layer become efficiently removed from solution by floating microorganisms which after their death settle into the deep water or all the way to the sea floor and release their concentrated compounds there. Because nutrients are not effectively replenished by transport upward across the boundary between deep water and the warm, sunlit sea surface, the biological production in this surface layer is insignificant. Most tropical ocean waters are, thus, sterile, transparent, and blue.

Turbulence along the back of the Equatorial Undercurrent, however, brings the cold, deep water into the sunlit surface in a narrow zone along the equator, resulting in high production of plankton there. This narrow zone of the sea surface then becomes a strip of fertile oasis amidst the desert of the equatorial ocean, with flourishing plant life in these liquid pastures supporting a large population of animals, including squid and fish.

The rain of organic debris from life in the equatorial zone drops like a curtain from the fertile surface layer, touching the seabed about 5,000 meters below. This debris provides food for the animals on the sea floor and contains a variety of trace metals such as cobalt, copper, nickel, zinc and barium, which have been concentrated a thousand- to a hundred-thousandfold from their very dilute solution in seawater.

The strip of sea floor below the equatorial zone of high productivity is, consequently, marked by a high rate of deposition of these metals, of phosphate from skeletal fish debris, and of other biotic remains. This high deposition

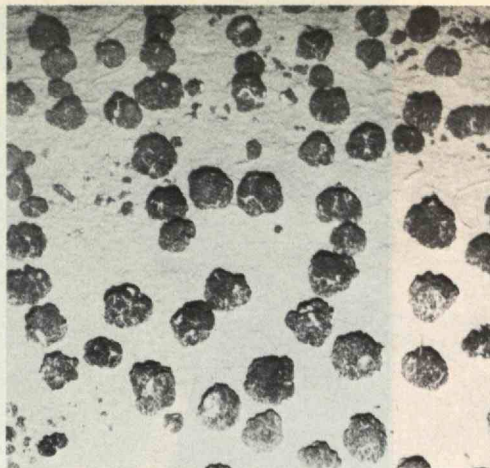
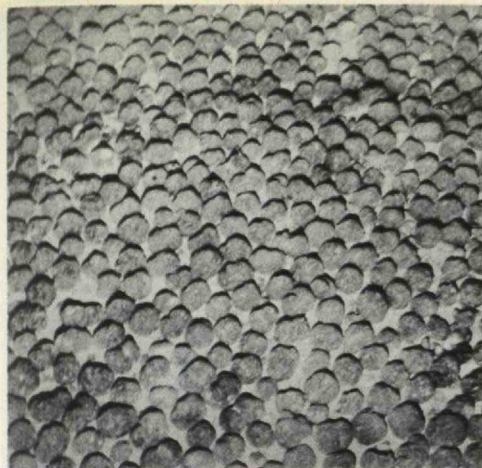
rate, however, does not directly result in a high concentration of these components on the sea floor, since there is much calcium carbonate and silica from skeletal remains that also rain down and dilute the deposit of metal compounds.

But another set of concentration mechanisms operates to further upgrade the equatorial metal deposits. One of these processes is the dissolution of the calcium carbonate component of the biogenic debris. On the flanks of the equatorial area of biologically produced carbonate sediments — a region 5° to 10° north and south of the equator — production of the carbonate shells of plankton is low enough to be completely offset by dissolution. Thus all of the sedimentary calcium carbonate is removed, leaving behind siliceous ooze, containing the biogenic minor and trace elements.

The peculiar formations known as manganese nodules are of crucial importance in the further concentration of these elements. These nodules occur at varying population densities and shapes, not only in the equatorial Pacific, but in many areas of the entire world ocean floor. It has lately become clear that colonies of animals live on the nodule surfaces and contribute to the growth of the nodules. These animal colonies have a life style similar to that of corals in that they protect themselves in hostile surroundings by building armored structures from sediment grains and substances precipitated from seawater. Perhaps — we know nothing about this aspect — they ensure their survival by some form of symbiosis. For corals, calcium carbonate is the most advantageous substance for shell construction, since it is near saturation or is supersaturated in the surface layer of the ocean where the corals live. But the nodular animal colonies on the deep-ocean floor appear to use iron and manganese oxides in their armor, since calcium carbonate, for most purposes, is too soluble at the low temperatures and high pressures of the deep-ocean environment.

Reef-forming corals select an initial growth base of any kind of rock, sedimentary or volcanic, that sticks up into their ecological niche, the surface layer of the tropical ocean. Similarly, the manganese nodule organisms appear to base their construction on any hard object found lying on the surface of the mushy, deep-sea ooze — a whale bone, a fish tooth, a piece of pumice, basalt, or sediment, a single microscopic nodule or cluster, or a fragment of a pre-existing nodule.

Sunlight, stored in the organic compounds raining into the darkness is the ultimate driving force for these life processes on the deep sea floor. This is the same energy



Left: Vast fields of manganese nodules cover much of the deep ocean floor, but only in special regions, such as adjacent to the Equatorial Undercurrent, do they contain substantial amounts of copper and nickel. Right: Small organisms are often seen attached to the nodules; and crawl-tracks and burrows from larger organisms are frequently seen in the sediments surrounding the nodules. This field of irregular nodules is situated in the central south Pacific. (Photos by Heezen and Hollister, 1971)

source which, in regions of the ocean where it is not burned again by the bottom-living animals, is eventually turned into shale oil and petroleum. In the equatorial Pacific copper-nickel ore zone, as in most open ocean areas, the fuel is used instead as life support by the deep animals living both on the nodules and in the sediment.

The incorporation of copper and nickel may possibly be controlled by the life activities of members of these nodular organism colonies, but we don't know much about the nature of the incorporation process. For example, we are not sure if the copper and nickel are incorporated as solid grains from the sediment, and then transformed in the nodule community; if they derive from sedimentary biogenic precursor minerals in solution; or if they are taken up directly from a seawater solution or suspension. We do know, however, that the resulting concentrations of copper and nickel are particularly high in areas such as the equatorial high-productivity region, where the supply to the seabed of copper and nickel is enhanced.

The potential ore body represented by the copper-nickel-rich nodules is immense. The north equatorial copper-nickel-rich nodules alone cover an area of 3.5 million square kilometers, which corresponds to one half of the area of the United States, or six times the area of France. The total mass of copper-nickel-bearing nodules in this and in the similar zone south of the equator has been estimated at 10 to 100 billion tons with a content of 10 to 100 million tons of copper and nickel — about the same magnitude as the total estimated resources of copper and nickel on land. So, if a major part of just the Pacific deposits proves to be available, this could mean a doubling of the known world resources of these two metals.

Whether they can be made available depends on complex geological, technological, economic and political questions.

Geologically, we must know if the grade and surface density of the nodule fields is sufficiently high and uniform. Studies published in the open literature are not yet comprehensive enough to answer this question. However, a vast number of observations has been made over the last decade by industrial organizations, following the initiative of Dr. John E. Mero of the University of California, Berkeley. But industry has revealed relatively little of its knowledge. The best measure of the confidence industry has in this resource's potential is its continuing investment, by now at least a hundred million dollars.

Technologically, we must determine if satisfactory

methods can be developed for mining the ore. Pilot-scale experiments have already been carried out with two different mining techniques. One, the continuous line bucket system uses an endless loop of wire rope extending to the sea floor with buckets attached at close intervals. In full-scale operation, two ships keep the loop open at the surface and pull it along as the lower end trails over the sea floor collecting the nodules and associated sediment. While this system is relatively simple and flexible, some experts doubt whether the nodules can be removed rapidly enough using it.

The hydraulic-lift technique involves sucking ocean-bottom material into a mining head moving over the ocean floor. The nodules are lifted by injected air through a rigid pipe system to the collecting vessel at or below the surface. While this system might have a potentially high capacity, it is cumbersome to deploy, retrieve and repair; and it is difficult to maneuver and safeguard the mining head as it moves over the deep-ocean floor.

Variations in grade and abundance of nodules as well as in bottom topography could be major obstacles to nodule mining in a given area. Conventional echosounding techniques reveal the deep sea floor to be deceptively smooth below the dimensional scale of hills and seamounts. But in at least some areas of the potential mining zone, modern high resolution techniques have revealed occasional, small-scale topographic features with steep slopes, such as scarps and faults. Such irregularities could greatly complicate or jeopardize nodule recovery efforts, if ocean miners use rigid collection devices.

Metallurgical techniques to economically recover copper and nickel from the nodules represent another important technological question. One method involves extracting the desirable components without complete chemical breakdown of the nodule framework of manganese and iron hydroxyoxide minerals. While relatively little energy is expended in such a method, recovery of copper and nickel appears to be incomplete. But if the entire structure of the nodules is dissolved, more energy and chemicals are needed, but complete recovery is ensured. As a bonus, large amounts of manganese in the form of Mn^{2+} are made available.

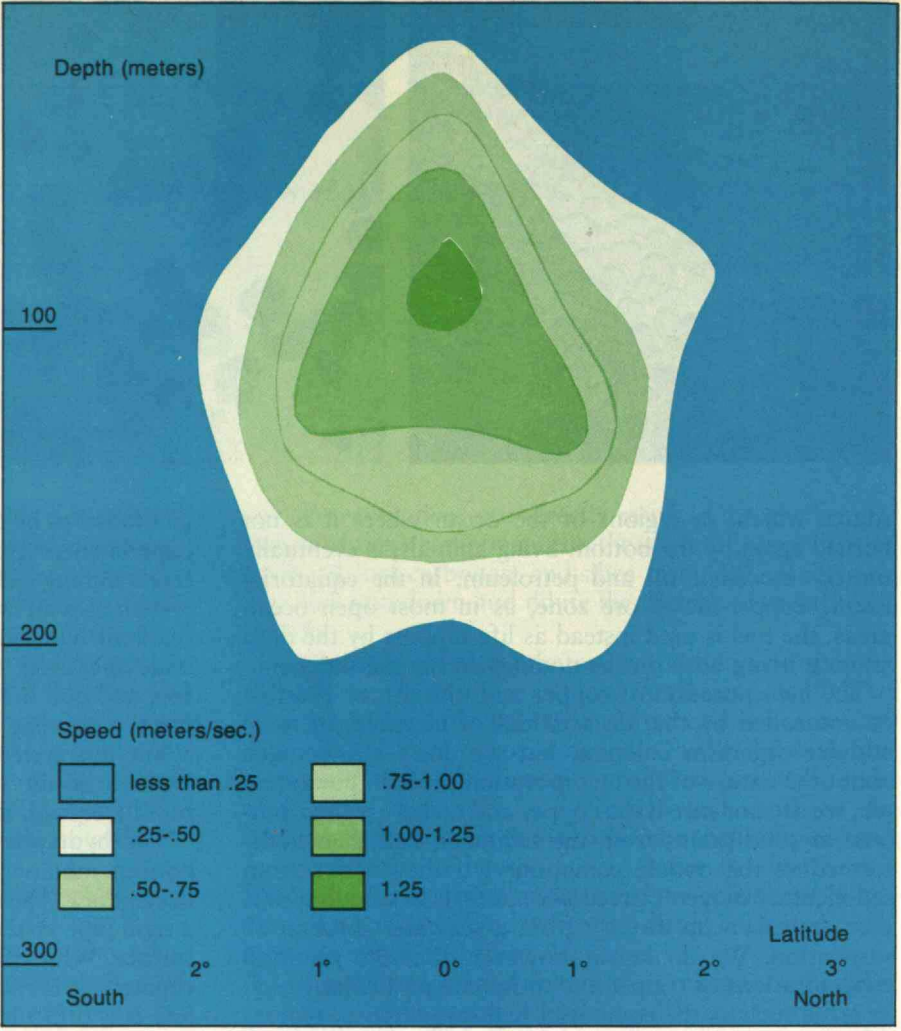
A crucial legal and political question is the ownership of the sea floor — does it belong to everybody or to nobody? In the past, the unexplored regions of the earth seemed practically endless; there appeared to be no reason to deny the pioneer and his flag the right to any unclaimed (or unprotected) resources he discovered. Today, we are increasingly aware of the closed surface of

Left: Vast fields of manganese nodules cover much of the deep ocean floor. Only in special regions, such as adjacent to the Equatorial Undercurrent, do they contain substantial amounts of copper and nickel. Small nodules are often seen attached to the nodules, and crew members are often seen collecting them. The nodules are often seen attached to the nodules, and crew members are often seen collecting them. The nodules are often seen attached to the nodules, and crew members are often seen collecting them.

Left: Vast fields of manganese nodules cover much of the deep ocean floor. Only in special regions, such as adjacent to the Equatorial Undercurrent, do they contain substantial amounts of copper and nickel. Small nodules are often seen attached to the nodules, and crew members are often seen collecting them. The nodules are often seen attached to the nodules, and crew members are often seen collecting them.

The Equatorial Undercurrent, shown here in velocity cross section, runs from west to east in the Pacific about three hundred feet below the surface. The swiftest core of the current is a thin ribbon of water about 50 miles wide and only 100 ft. thick, speeding along at a core speed of four ft. per second — faster than the Gulf Stream.

Certainly one of the most remarkable features of the earth, this current gives rise to a high biological productivity in the surface layers of the ocean. The planktonic organisms extract trace metals from sea water and transport them to the seabed. (after Knauss, 1960)



our globe, and our competition for resources has correspondingly increased — the original “village” concept of the commons has extended to world level.

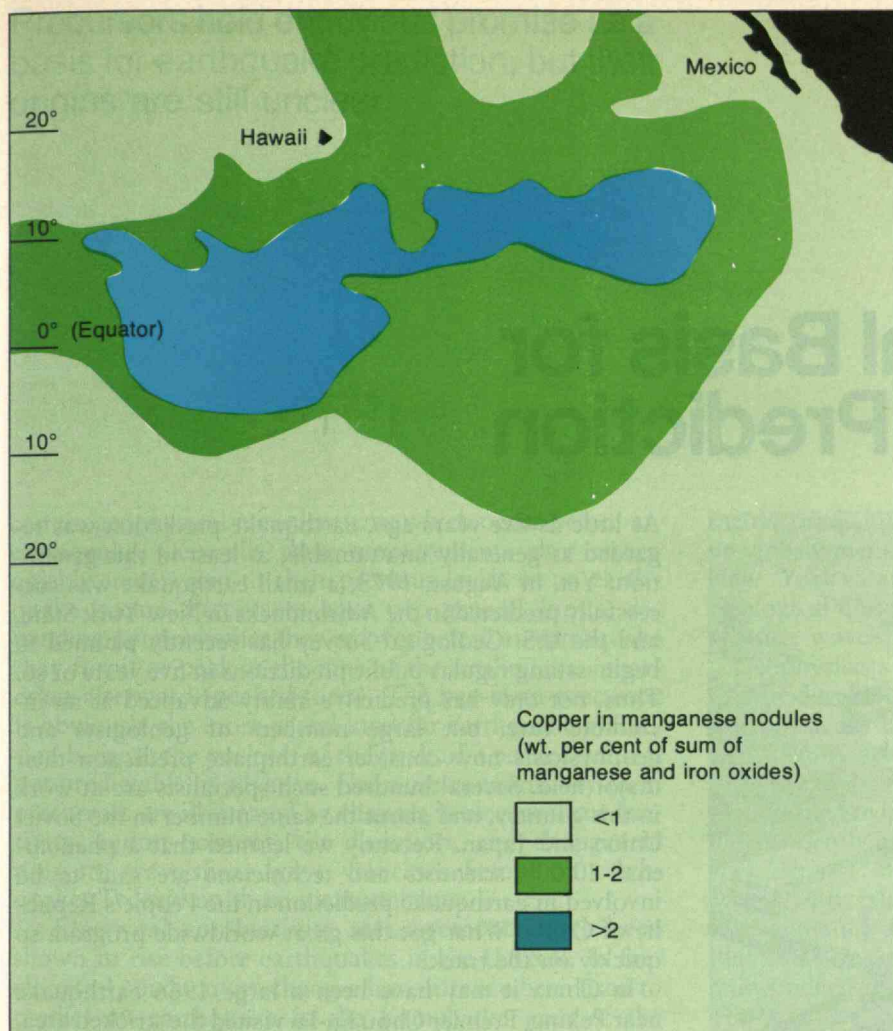
U.N. licensing of deep-ocean floor mineral recovery has been proposed as a way to secure revenue for nations less endowed with natural resources, while retaining the operational efficiency that seems most fostered by private enterprise. The United Nations Law of the Sea Conference in Caracas, Venezuela last summer took up the question of combining pragmatism and idealism in seabed management, and these discussions will be continued in Geneva, Switzerland in the summer of 1975. In the meantime, the U.S. government has declined to provide national protection for industrial deep-sea mining claims, presumably to avoid compromising this discussion.

The environmental impact of mining operations must also be thoroughly assessed. At present, we know little about the seabed ecology, including the microfauna on the manganese nodules themselves. However, the National Oceanographic and Atmospheric Administration has made an initial approach to the general environmental problems arising from deep ocean mining, but extensive multidisciplinary investigations will be needed.

The new world balance of resource availability and energy requirements that would be created by the opening of seabed resources would give rise to a whole host of new questions. These questions are different from the specific problems of large-scale recovery of new resources

in a largely unknown environment. For instance, if ocean mining is undertaken on any significant scale, manganese oxide or manganese ion will be generated as a by-product at a rate ten times larger than the copper and nickel production from the same source. The total world reserves of manganese would thus be increased about ten-fold by the Pacific copper-nickel resource alone. In an extreme case the entire world consumption of copper and nickel might be provided from seabed resources, and so manganese production would rise to a massive one-fifth of the present world production of iron. Even at a much more modest recovery rate, the present world need of manganese would be far exceeded by production. Current major uses for the metal are for removing oxygen dissolved in molten steel, and to a smaller extent, for alloying purposes.

Using manganese itself as a metal would present difficulties — it is brittle and differs in other physical properties from other members of the iron family of elements to which it belongs. The unique properties of manganese are reflected in its remarkable crystal structure. Manganese atoms, when they are stabilized in the regular arrays of the β -modification of the crystalline metal, assume two different resonant states, with two different effective sizes, and consequently, two different lattice positions. Manganese metal can thus be understood as a brittle alloy with itself. The metal might be practically useful if economical methods could be devised for modifying the electron structure to achieve the necessary toughness and



Copper content in the manganese and iron oxides of manganese nodules on the Pacific ocean floor. Optimal combinations of nodule coverage and copper-nickel content are found in the border regions of the equatorial high biological productivity zone, created by the Equatorial Undercurrent. (data from Frazer and Arrhenius, 1972)

other required properties.

Lesser industrial applications of manganese that might be encouraged by enhanced availability and low price are for catalysis and oxidation, and in agriculture, where manganese spraying has given promising results in the cultivation of peat lands. Such useful applications raise new environmental problems to be carefully considered.

This review barely touches on some of the many fascinating technical opportunities afforded by the world ocean. More important yet, we may hope that the ocean, like interplanetary space, will offer a political opportunity to place new sources of essential materials at the disposal of all of mankind.

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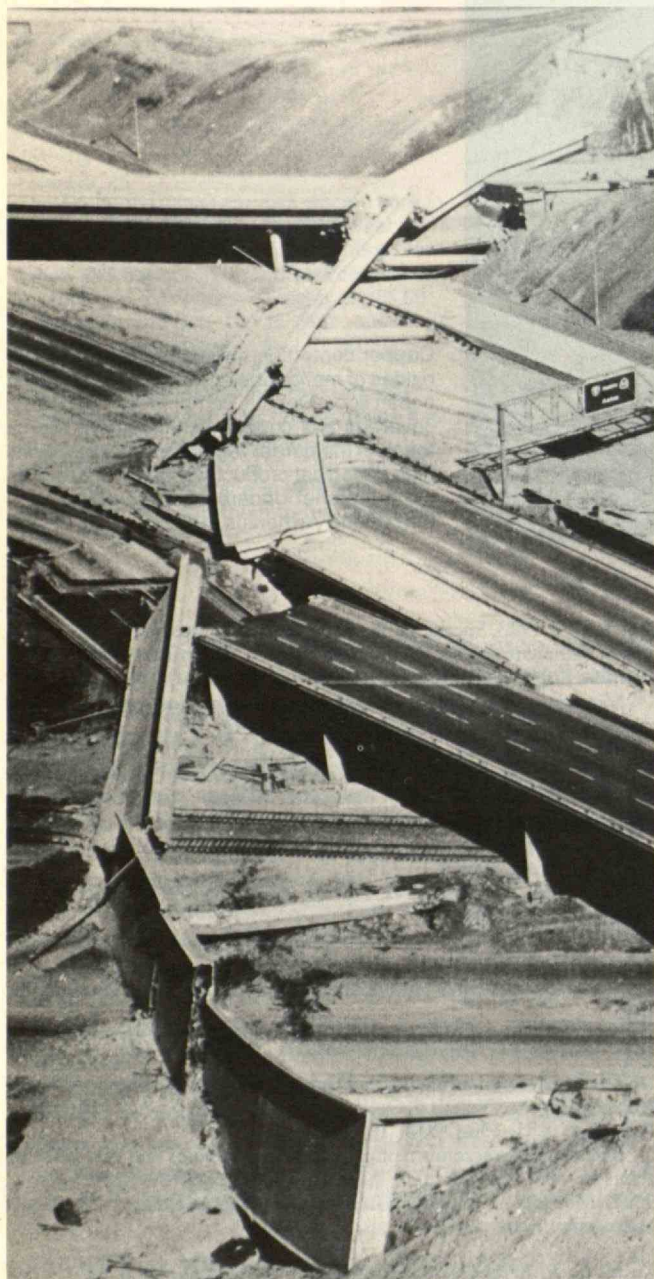
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The Physical Basis for Earthquake Prediction



Collapsed freeway overpass blocked traffic after a 1971 earthquake near Los Angeles. Devastation such as that wrought in Los Angeles, plus the specter of further earthquake activity in California, have spurred American efforts to predict earthquakes. (Photo courtesy Los Angeles Police Department).

As little as five years ago, earthquake prediction was regarded as generally unattainable, at least in this generation. Yet, in August, 1973, a small earthquake was successfully predicted in the Adirondacks in New York State, and the U.S. Geological Survey has recently planned to begin issuing regular public predictions in five years or so. Thus, not only has predictive ability advanced at an incredible rate, but large numbers of geologists and geophysicists now consider earthquake prediction their major field. Several hundred such specialists are at work in this country, and about the same number in the Soviet Union and Japan. Recently we learned that a phenomenal 10,000 scientists and technicians are said to be involved in earthquake prediction in the People's Republic of China. What got this great worldwide program so quickly on the track?

In China it may have been a large 1966 earthquake near Peking, Premier Chou En-lai visited the stricken area, and shortly afterward earthquake prediction emerged as the number one task of Chinese geologists and geophysicists. In the United States it may have been a report, to the Office of Science and Technology, of a panel headed by Frank Press, Professor of Earth and Planetary Sciences at M.I.T. The report called attention to the earthquake danger in California and urged extensive research on earthquake prediction. In any event, earthquake prediction is now a field with a great deal of scientific momentum and those involved are optimistic about not only predicting but also controlling earthquakes.

Earthquake prediction involves forecasting the magnitude of an earthquake as well as the time and area of occurrence. Prediction is done on at least two levels, the general and the specific — each involving a different technique. A general prediction, estimating the probability of an earthquake in a given area, is often based on pattern recognition requiring, of course, a pattern to recognize. This usually means a record of previous earthquakes for as long a period and as large an area as possible. Using this record, geophysicists may apply, for instance, the "gap" principle: gaps in historical earthquake activity records, particularly along plate boundaries, may become filled in time as those areas lacking earthquake activity "make up" their deficit. Of course, a prediction of the time and place of the earthquake which fills a gap is only as good as the historical record available. Such predictions, so far, have such large time uncertainties that they are not terribly useful.

Specific predictions are based upon recognizing what we call "precursors" of an earthquake — anomalies in

Precursors hold enormous promise as a basis for earthquake prediction, but their origins are still unclear.

certain geophysical measurements which occur before an earthquake. Generally these measurements alter rather quickly, recovering to their previous levels as an earthquake occurs. Precursors have two general forms, depending upon whether they recover before an earthquake (bay-form) or peak at the time of the earthquake, recovering afterward (peaked-form). The bay-form precursor is obviously the more useful kind for earthquake prediction because the position of the peak of a peaked-form is not predictable in advance. The more common bay-form precursors are illustrated by changes in electrical conductivity, radon content, tilt direction, and changes in pressure wave/shear wave velocities before an earthquake. To explain these measurements:

— Electrical conductivity measurements have been shown to rise before earthquakes in the U.S.S.R. In fact electrical conductivity changes have already been used to predict an earthquake in the Kamchatka area of the U.S.S.R.

— Radon is a gas produced by the radioactive decay of radium. Scientists have noted that the radon content of water in deep wells has shown a definite increase before some earthquakes.

— Ground tilt measurement to predict earthquakes was instituted by the Japanese. The technique has had some success — tilt changes were used to predict a number of small earthquakes that occurred in the town of Matsushiro between 1965 and 1967.

— However, the precursor that has shown the most promise is the drop in the ratio of two kinds of sound waves through rock — pressure waves and shear waves. Pressure waves, created by the forward and backward motion of particles, travel through rock faster than shear waves, created by sideways motion. Thus, pressure waves from a certain sound source, such as an earthquake or an explosion, will arrive well before shear waves from the same source. In such a case, the earthquake occurs just when the velocity ratio drop recovers to the pre-anomaly level. The beginning of recovery, therefore, signals an impending earthquake and the time of earthquake can be predicted once the rate of recovery is established. It is believed that the longer the duration of a drop and recovery, the larger the earthquake will be. In small earthquakes this duration may be only a few days, while a large earthquake may be preceded by a precursor of this type lasting years.

According to patterns discovered so far, the massive earthquake that struck Alaska in 1964, for example, would have shown a forty-year-long change in velocity

ratios had instruments been monitoring it. The previously-mentioned earthquake predictions made in New York State, by a group from Lamont-Doherty Geological Observatory, were made using the changes in pressure wave/shear wave velocity ratios.

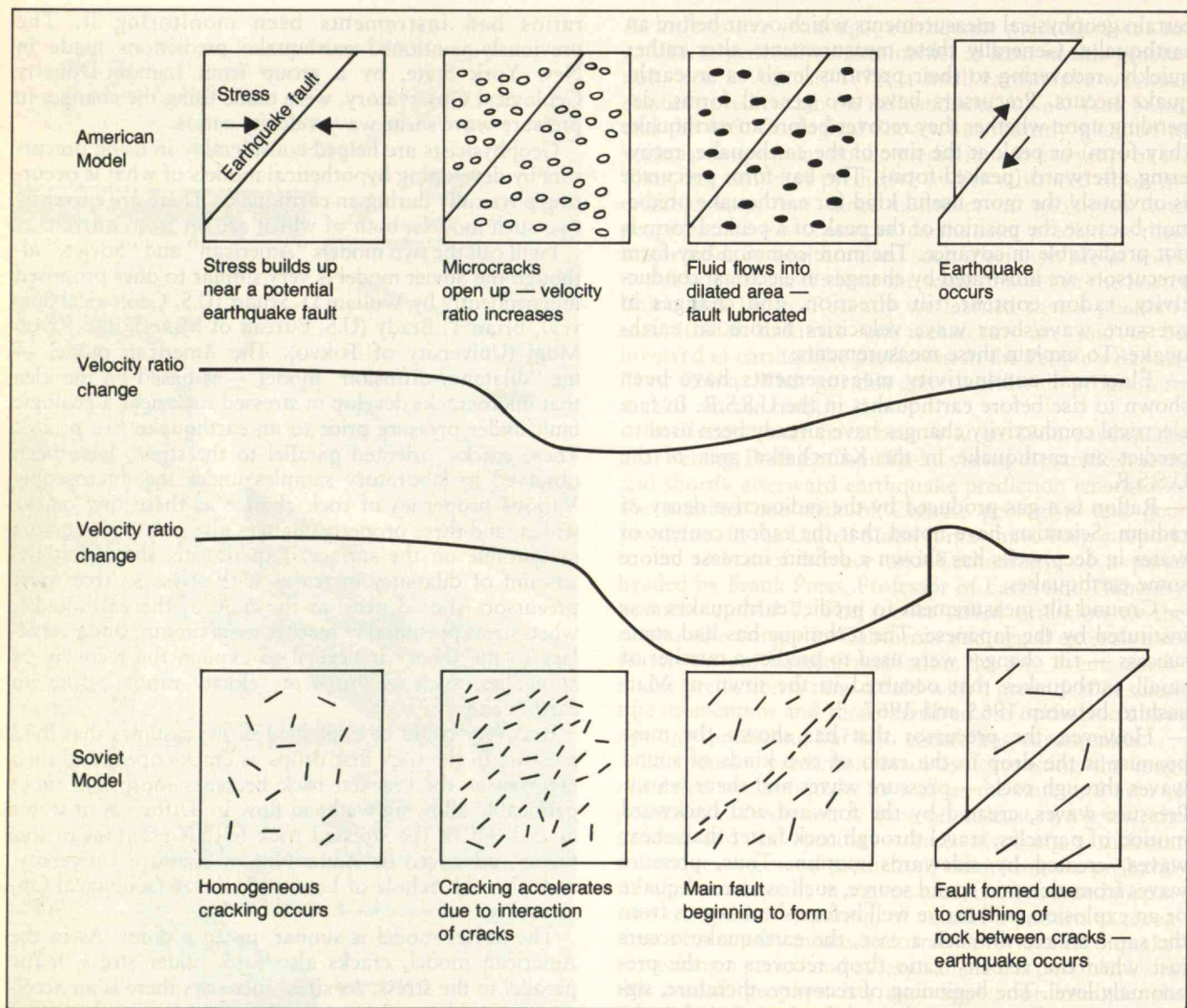
Geophysicists are helped considerably in using precursors by developing hypothetical models of what is occurring physically during an earthquake. There are currently two such models, both of which are far from proven.

I will call the two models "American" and "Soviet," although the Soviet model is very similar to ones proposed independently by William D. Stuart (U.S. Geological Survey), Brian T. Brady (U.S. Bureau of Mines), and Kiyoo Mogi (University of Tokyo). The American model — the "dilatancy-diffusion" model — is based on the idea that microcracks develop in stressed rock near a geologic fault under pressure prior to an earthquake (*see p. 28*). These cracks, oriented parallel to the stress, have been observed in laboratory samples under the microscope. Various properties of rock change as these tiny cracks widen, and these property changes give rise to precursors measurable on the surface. Experiments show that the amount of dilatancy increases with stress so that most precursors should peak at the time of the earthquake, when stress presumably reaches a maximum. But a corollary to the theory is needed to explain the recovery of anomalies, such as drops in velocity ratios before an earthquake.

Recovery could be explained if one assumes that fluid pressure in the rock first drops as cracks open, and then recovers as the cracked rock becomes more and more permeable allowing water to flow in. Diffusion of water in and out of the stressed rock is thus essential to this theory, advanced by Amos Nur of Stanford University, and Chris H. Scholz of Lamont-Doherty Geological Observatory.

The Soviet model is similar, up to a point. As in the American model, cracks also form under stress, many parallel to the stress. As stress increases there is an acceleration in this crack growth. But according to the Soviet model, cracks then begin to form in a new direction, to lengthen in the direction of the fault, forming segments, as it were, of the eventual break. When this happens the general stress level drops and cracks close, except in a narrow zone near the eventual rupture. The earthquake occurs after some period of crack closure, when stress has fallen appreciably. The recovery of velocity ratios in the Russian model therefore does not require water flow in and out of the rock, but is achieved by the slow stress

The Physical Basis for Earthquake Prediction



Two hypothetical models are currently being advanced to explain the behavior of precursors before an earthquake. The "American" model holds that the opening of microcracks in rock under pressure, and their subsequent filling with water, explains

precursor behavior. The "Soviet" model suggests that the cracks lengthen and join to form an earthquake fault, and a drop in stress level before an earthquake causes precursor changes.

New Opportunities for Offshore Petroleum Exploration

drop allowing cracks to close during the second half of the anomaly period before an earthquake.

In the Soviet model, the earthquake occurs when the main fault forms, produced from the slowly growing segments by a grinding down of the solid material between them. According to the prevailing American scheme, the earthquake could correspond to formation of a fault, or simply to stick-slip motion on a preexisting fault which had been locked by friction.

Which of these models best applies to the earth? For earthquakes on preexisting faults as at California's San Andreas fault, the American model is apparently more appropriate. But whether this is the case or not, measurements of stress or pore pressure variation in the rock ought to yield information that would help decide between the two. For example, the Soviet model predicts a strong decrease in stress prior to the main event. And the American model requires pore pressure changes that should be detectable. Also the American model, but not the Soviet, requires precursor changes of a duration proportionate to the earthquake magnitude.

The manner in which recovery of a precursor takes place could also distinguish the Soviet and American models. Most of the anomalies should begin to disappear before the earthquake for the Soviet model — it should have a bay-form. For the American model most anomalies should peak at the earthquake, except for velocity ratio changes. This is because the maximum amount of microcracks would be present then, causing the maximum geophysical measurement changes.

Post-earthquake recovery should be slow in the American model, taking a time scaled to the earthquake magnitude; recovery in the Soviet model may be instantaneous.

Finally, any changes in direction of properties during the anomalous period, away from the edges of the rupture, would favor the Soviet model. This is because the Soviet model postulates change in cracking direction near peak stress. Researchers have seen several such changes in direction: The focal mechanism of small earthquakes may change just before the main shock; in central California tilt direction shifts similarly. It is not clear how these could be explained by the creation of microcracks postulated in the American model.

Thus, there would appear to be many ways in which validity of these models can be tested. Perhaps we will end up combining the better features of the American and Soviet models. It is also possible that no one model will apply in all geologic settings. In any event, the next few

years will be exciting as new precursory observations are reported from the many large groups now at work in this new field of earthquake prediction.

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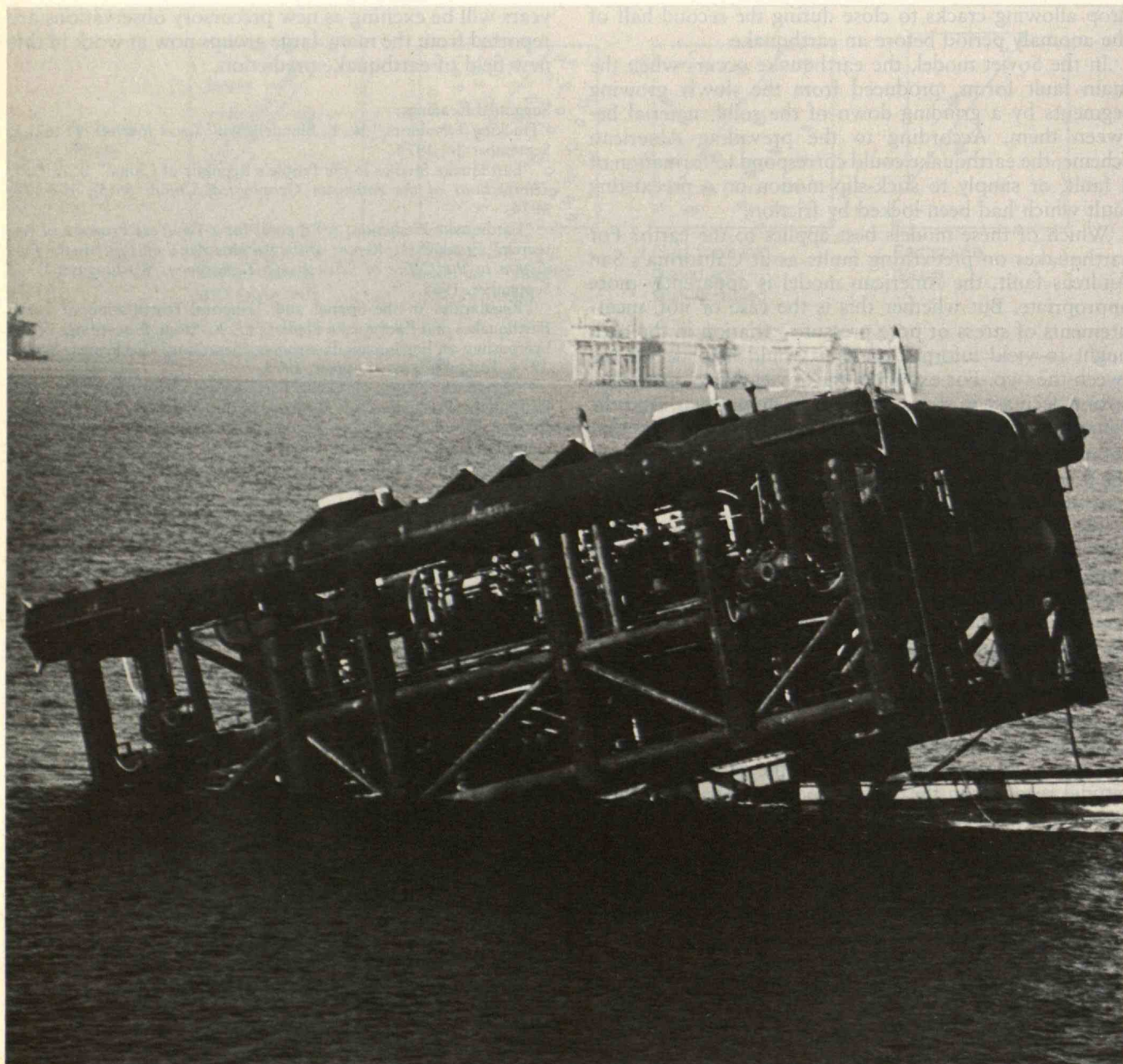
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William F. Brace, Professor of Geology at M.I.T., received his Ph.D. in geology from M.I.T. in 1953, and was a Fulbright Fellow and a geologist with the U.S. Geological Survey. A member of the National Academy of Sciences, he lists his research interests as the mechanics of rock deformation, experimental structural geology, the effects of high pressure on the properties of rocks, field analysis of fracture and strain patterns in deformed rocks, and the mechanics of crustal earthquakes.

The continental shelves, marginal basins, and continental rises may hold generous petroleum resources. Their exploration will depend as much on political as on technological genius.



Subsea oil production systems, such as this one launched for testing last fall by Exxon, could allow drilling at far greater depths than possible with platforms. Platforms can economically drill in water up to about 600 ft. deep, while subsea production systems could produce petroleum from depths of thousands of feet. The system is sunk to the ocean floor, and wells drilled through it by

special drilling ships. Once oil is found, the production system automatically controls pumping of the petroleum into tankers. The National Petroleum Council estimates that as much as one-third of the world's offshore petroleum reserves may be found beyond 600-ft. water depths. (Photo courtesy Exxon)

New Opportunities for Offshore Petroleum Exploration

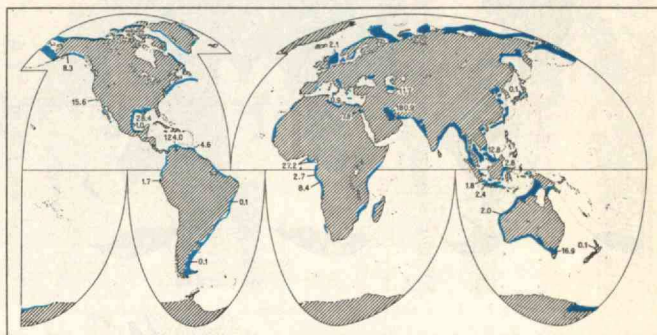
Any consideration of world opportunities in offshore petroleum must take into account the incredible exponential growth in knowledge about the oceans since World War II, which is continuing today.

Using such techniques as seismic reflection and refraction, gravity and magnetic measurements, and such then-new tools as war surplus research vessels and later submersibles, man began at the end of World War II to plumb the ocean in earnest for the first time.

And oceanographers started very primitively. I remember being on one three-month cruise just before the war, in which the major geophysical experiment was to measure the depth of the water using a flashing-light echo sounder. We sat by the instrument writing down the depth every two minutes, day and night, for three months.

Besides the relative newness and rapid growth of much of the knowledge of the oceans, offshore exploration — especially of the continental margin — must also contend with the complex problems of conducting explorations across political boundaries. Reconnaissance can be done only in areas where political boundaries are weak or nonexistent for one reason or another. This has been difficult enough until now, but recent developments in the law of the sea are making it almost impossible to obtain permission from certain countries and in general from groups that include many countries. For example, one study I would like to make of the sea floor of the Caribbean involves 22 countries, including a wide variety of governments with variable procedures and levels of suspicion and friendliness. We have just finished a study off western Africa which covered ocean-floor territories claimed by 27 countries — a study I would hesitate even to consider now with present political and legal complications.

So, with this brief explanation of the difficulties involved in obtaining information, let us turn to the information we presently possess. The map on this page shows the world production of crude oil on the continental shelves in 1972. The blue areas represent the parts of the continental shelf that I believe contain the provinces having the best prospects for economic deposits of oil and gas. Only parts of these areas have been explored and developed; successful results are indicated by the figures on the map, showing the production of oil in terms of millions of tons during 1972 (1 ton is about 7.5 bbl. each of 42 gal.). Chief underwater production is from the Persian Gulf and Lake Maracaibo (in Venezuela), but important production also occurs in the Gulf of Mexico, off



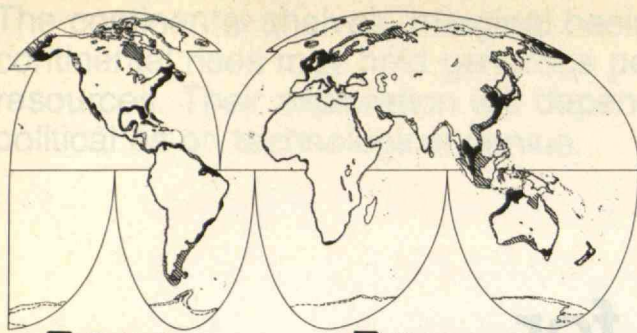
Many of the most accessible areas of the world's continental shelves are already explored, and oil is flowing from them; the figures show the 1972 production of oil (in millions of tons) from parts that are being exploited. Yet some areas which the author believes have good prospects for petroleum production (in color) remain untapped and some even unexplored owing to political and technological constraints.

Nigeria, and off southern California. At high latitudes many areas shown in blue remain unexplored owing to the restraints of severe climate. Many areas at lower latitudes are unexplored (at least no results have been published) and undrilled because of political restrictions; chief among these areas are the shelves off Communist or strongly Socialist countries such as the U.S.S.R. and its European satellites, India, Burma, Guinea, and the People's Republic of China. In a very few other areas exploration has occurred but drilling has been stopped by environmentalists who fear coastal pollution; these are chiefly around the United States: the Atlantic shelf, the Santa Barbara Basin off California, and the general Gulf of Alaska.

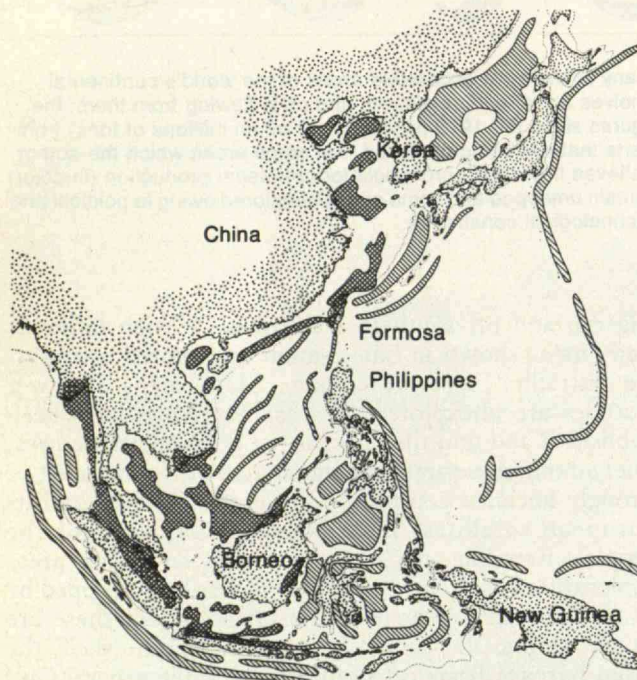
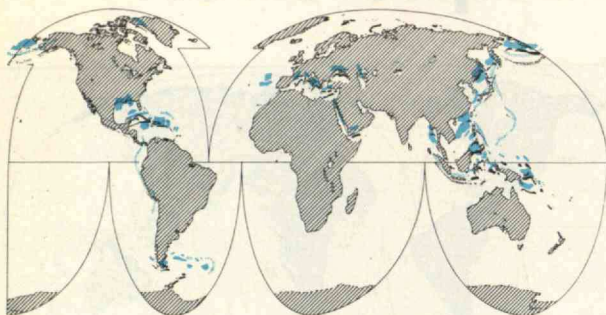
We have a moderate knowledge of large areas of the continental shelf but complete knowledge of only a few areas, mostly off the United States and Europe. Oil industry and oceanographic institution explorations are the sources of most knowledge of topography, sediments, lithology, and structure. Thorough knowledge of the structure of the strata in an area must be available before any oil can be developed, so in most offshore areas of the world we still have a long way to go.

The Unknown Resources of the Deeper Sea

So far, I have been strictly factual in my presentation; now begins the speculation. The marginal basins of the world (near the boundaries between the continental crust



□ Poorly known ■ Well known
 ▨ Moderately known Shelf break



Top: Only parts of the world's continental shelves are known even moderately well, and fewer have been explored sufficiently to yield sediments, stratigraphy, and structure. Such detailed knowledge is prerequisite for the development of offshore oil.

Center: Deep marginal basins (solid color) and marginal trenches (dots) are associated with the convergence of ocean-floor and continental plates. Many of these basins may become oil provinces of the future, but both extensive exploration and new technology will be required for their development.

Bottom: Many marginal basins off eastern Asia are promising for petroleum resources; some are only partly filled with sediments (single hatched), whereas others underlying the continental shelves have been filled to overflowing (double hatched). Political — rather than geological — issues are likely to dictate the way in which these promising formations are explored and exploited.

and oceanic crusts) represent a promising source of offshore oil; they are geologically interesting because most of them are areas of convergence of sea-floor crustal plates with continental plates. An example is the belt all around the Pacific where the Pacific floor is underthrusting the Asian continent, and that area of the Caribbean where part of the Atlantic floor is underthrusting the West Indies. All of these belts of convergence are marked by long narrow deep trenches — the deepest parts of the ocean. The marginal basins of potential economic interest are inshore of and shallower than the deep trenches; their interest derives from the fact that continental sediments containing organic matter have accumulated here over the history of continental movements, and important deposits are likely. But exploration of them must await new drilling technology for use in deep waters.

Some other small marginal basins or troughs have formed where continental plates have diverged or where there is no present relative movement of ocean floor and continent. Examples occur along the coasts of western Africa and eastern North America. The rifts which produced the troughs formed so early (about 180 million years ago) that they mostly are filled with continental deposits and probably contain no extensive marine organic deposits that might have evolved into oil.

The prominent role played by politics in determining the discovery and exploitation of marginal basins is evident along the coasts of eastern Asia. I have been fortunate to make a number of studies in this region, and from them I have put together the general picture of the basins' potential oil deposits which appears as the center chart on this page.

Shortly after we made a study of the East China Sea (without permission from Chairman Mao and thus very circumspectly), the interested nearby countries rapidly divided up the area. Japan, South Korea, and Taiwan all claimed various and overlapping portions, and one spot was claimed by all three. All three countries have, in fact, leased the area to various oil companies. After fulminating for a period and vocally complaining about American imperialists and Japanese militarists (or is it vice versa?), the People's Republic of China claimed the whole offshore area, even further confusing the picture.

Farther south in the deep China Basin are folded ridges that rise nearly to the water surface as reefs and that can serve as natural drilling platforms. As most of them are slightly below sea level, they are not claimable by international law. Now one of the ridges is surmounted by a group of small islands, the Paracel Islands, that is claimed by mainland China, Taiwan, the Philippines, South Vietnam, and France. Their rivalry has become quite hot: In January, 1974, the South Vietnamese sent two patrol vessels to reinforce their claim, whereupon the People's Republic of China reinforced its own claim by promptly sinking the ships. As in many other areas, knowledge of the sea floor has stimulated political rivalries, but ultimately the knowledge will result in the production of oil.

The continental rises (*top map, page 33*) also hold considerable promise for offshore exploration. They occur in areas of divergence of sea floor plates and are notable for their relatively great depths — 1500 to 3500 meters — and thick sediments (which is why they hold promise for petroleum). Perhaps half the Earth's sediments are in these features.

One added assurance of oil deposits under the conti-

mental rises is the presence of salt domes. These features are huge pillars of salt that have thrust their way upward through later (and heavier) sediments and have deformed the sediments en route so as to make many oil traps. In fact, most of the oil that has been obtained from the Gulf Coast region of the United States is from these traps beneath the continental shelf. But we have not yet exploited those in deeper water.

Still other deposits are farther out to sea, and their development will not take place for a number of years.

Forecasting: Integrating Technology and Politics

Uncertainty is the theme of any attempt to forecast future supplies of petroleum from offshore. We know already that the continental shelves contain petroleum and that the shelf off North America may contain a lot. However, little is known about the oil potential of most shelf areas.

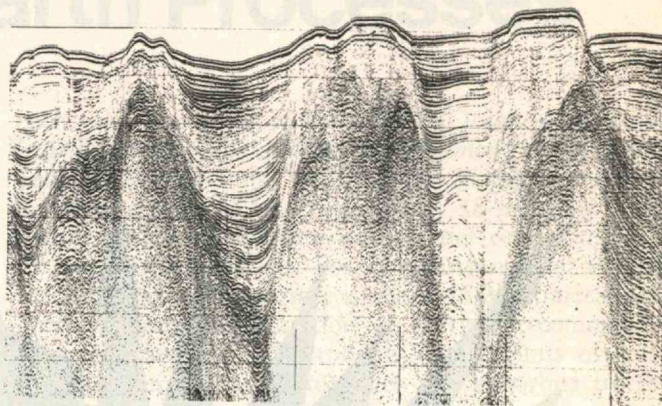
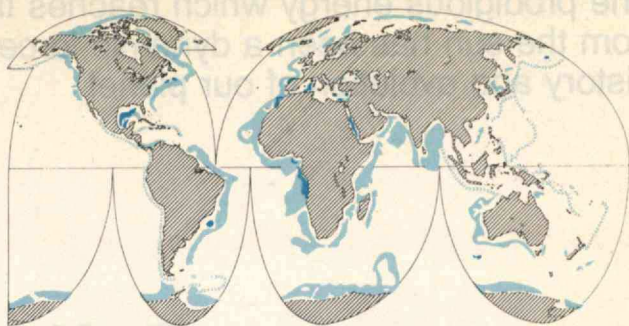
And, of course, we know even less about the deep basins and continental rises. In fact, there is so little knowledge that the joint oceanographic institutions' deep-sea drilling project, funded by National Science Foundation, is not allowed to drill continental rises for fear oil might be struck and cause extensive pollution to the ocean.

Besides all this geologic uncertainty, there is also a large aspect of political uncertainty to any prediction of oil recovery from offshore explorations. Law-of-the-sea negotiations almost certainly will result in adoption of the 200-mile limit for an adjacent country's control of natural resources from the ocean floor. This means essentially that northern high latitudes, except far to the north in the Arctic Basin, can be closed to exploitation and even to oceanographic research.

By far the largest portions of these zones are off the U.S.S.R. and the People's Republic of China, nations which are unwilling to allow research in their waters. Other developing countries as well may jealously guard their waters from research vessels; Cuba is a notable example. The only real possibility for large-scale exploration appears to be off the shores of very large countries such as Brazil and Chile.

In any case a new kind of geologist will be necessary for future explorations. He will need political talents to arrange permissions and authorizations, taking into account the different laws and forms of government of the countries with which he must negotiate; and he will also need financial talents to obtain funding. These qualifications are in addition, of course, to the very considerable scientific and technical talents necessary to accomplish this work. In fact, eventually there will be reached a point of diminishing returns, at which the negotiations simply will not be worth the trouble for the scientific knowledge gained.

Kenneth O. Emery has been a Senior Scientist at the Woods Hole Oceanographic Institution since 1963, and he was Acting Dean of its Graduate Studies Division in 1968. A native of Canada, Dr. Emery studied at the University of Illinois and Scripps Institute of Oceanography and came to Woods Hole in 1962 from the Geology Department of the University of Southern California. A member of the National Academy of Sciences, he holds its Alexander Agassiz Medal for distinguished contributions to oceanography.



Continental rises are commonest in the Atlantic and Indian Oceans, whereas the marginal basins (page 32) are commonest in the Pacific Ocean. The rises may contain about half the world's total volume of sediments, and they must therefore be considered potential major sources of oil and gas. The presence of deep-water belts of salt domes makes certain areas especially promising; such pillars of salt create oil traps by deforming sediments. The seismic reflection across salt domes off Angola (below) are characteristic; the vertical dimension of the profile represents about 2 km. depth, the horizontal about 30 km.



If a 200-nautical mile territorial sea is eventually accepted as the law of the sea, large areas of the ocean floor which have special promise for petroleum and other mineral resources will come under the control of individual nations, many of which are likely to restrict exploitation and even research.

The prodigious energy which reaches the earth from the sun has been a dynamic force in the history and evolution of our planet



Brush drawing by Jean Lurçat

Solar Energy In Earth Processes

In his invitation to participate in the symposium honoring Cecil and Ida Green, Frank Press proposed that I focus on the general subject of natural resources and suggested that "it would be appropriate for you to express some new idea that you have recently entertained, some new policy directions, some recommendation for government or industry or universities, or your predictions of things to come." When I accepted, I thought I would probably pass the first of these options; as an administrator of an organization that is rapidly expanding to meet some of the critical resource and environmental problems facing this country, my thoughts these days are mainly directed to program and management problems that are not of general academic interest. Several weeks thereafter, however, I did embark on what was for me a new train of thought concerning the earth's use of solar energy — a topic that I believe is appropriate for this symposium on "The New Wave of Exploration in the Earth Sciences."

The stimulus for this inquiry was a few paragraphs I was reading on plate tectonics, describing the movement of an oceanic plate beneath a continent and the igneous activity and mountain-building that result. Suddenly, I thought: What an enormous amount of energy is involved in the crustal and mantle processes that are responsible for the movement of crustal plates, the drifting of continents, mountain-building and crustal uplift and downwarp, igneous intrusions, and volcanic eruptions. How much is it and where does it come from? This line of thought led naturally to a list of the sources and, presently, to some notes on their magnitude and significance.

First, there would be primordial energy, consisting of the earth's rotational energy, some amount of residual heat, and most importantly, the gravitational energy represented by the earth's mass. Then there would be the heat generated by the decay of uranium, thorium, potassium, and other radioactive elements. At that point I wondered if there might be some input of captured and stored solar energy.

This is the topic I found so interesting, for — although it appears that captured and stored solar energy represents only a small fraction of the energy in the earth and probably contributes to processes that operate only in the shallower part of the crust and at the surface — solar energy has been captured in more diverse ways and has contributed more to geologic processes than I had realized.

The Sun as a Dynamic Agent in Earth History

Approximately 1.5 quadrillion (1.55×10^{15}) megawatt hours of solar energy reach the earth's outer atmosphere

each year. According to Peter Weyl (*Oceanography: An Introduction to the Marine Environment*, New York: John Wiley and Sons, 1970), about 35 per cent of this amount is reflected back into space, 18 per cent is absorbed by the atmosphere, and 47 per cent is received by the earth's surface. For comparison, the amount reaching the earth's surface is about 13,000 times man's current annual consumption of energy in commercial forms, excluding food. Probably the amounts of solar energy reflected back into space and absorbed by the earth and its atmosphere have not been constant over geologic time, but however they may have varied, the total amount received over the earth's 4.5 billion year history staggers the imagination. Most of this has been radiated back to space, but some of the solar radiation absorbed has been used to heat the earth's surface or to supply the energy for photosynthesis, evapotranspiration, and other earth processes. Some of these processes form products that still retain energy, such as that in plant matter. The fossil fuels represent such captured and stored solar energy, of course, but what are other examples?

Because very large numbers are involved in describing energy used in earth processes, in the discussion that follows I use the amount of solar energy reaching the outer edge of the earth's atmosphere each year — the figure I have already mentioned of 1.5 quadrillion megawatt hours — as an energy unit, and report other amounts of energy as rounded multiples or fractions of that unit, which I will call a SERPY, abbreviated from "solar energy received per year." Keep in mind that a SERPY is a very large amount of energy — about 28,000 times as much as man now consumes each year.

Returning to the subject of captured and stored solar energy, one of the major contributions of solar energy has been the warming of the surface and near-surface part of the earth's crust. To appreciate the grand contribution of solar energy to earth processes, imagine what the earth would have been like without it. Bernardo Grossling of the U.S.G.S. estimates that without solar heat, the temperature of the earth's surface would be about -280°C ., or about 253°C . colder than it is now. The heat stored in the upper part of the crust that is of solar origin resulting from thermal conduction in a solid model, throughout the life of the earth, Grossling estimates to be about 32,000 SERPYs. If one were to allow for the convective motion involved in sea floor spreading, the amount carried into the earth would be larger still. Without that heat — that is, at surface temperatures of -238°C . — hydrogen would condense and water would exist only as ice. Nothing resembling the oceans, even in the form of

ice, would exist, and the processes of erosion and sedimentation which so influence the configuration of the earth's surface would never have come about. Inasmuch as the organic building blocks from which life was formed are thought to have resulted from ultraviolet radiation of compounds such as methane, life would not have begun, nor could there be photosynthesis or any other of the processes driven by solar energy. So, solar energy has indeed been of fundamental significance in earth history.

When I began to think of how solar energy may have been captured by the earth, one of the first things that came to mind was the oxygen atmosphere, which is a product of photosynthesis and, according to the late Gerard P. Kuiper (*The Sun*, Chicago: University of Chicago Press, 1953), to photodissociation of water vapor to oxygen and hydrogen. Atmospheric oxygen represents an enormous store of chemical energy responsible in large part for the weathering and decomposition of both organic and inorganic materials at the earth's surface. Motokai Sato of the U.S.G.S. estimates that existing atmospheric oxygen corresponds to the energy storage of nearly 3 SERPYS (4.4×10^{15} Mwh.). As atmospheric oxygen is rejuvenated every 3,000 years, the total energy captured since Mississippian time (350 million years ago) amounts to 350,000 SERPYS (5.1×10^{20} Mwh.), of which Sato estimates about 44 SERPYS (6.6×10^{16} Mwh.) have been fossilized. Most of this fossilized oxygen has been used for the oxidation of ferrous to ferric iron and sulfide to sulfates in sediments and natural waters. It is interesting to note that, whereas a large portion of the stored solar energy is dissipated as heat of oxidation in these processes, the reduction of hematite to magnetite or of sulfate to sulfide by organic matter is exothermic, so fossil oxygen still stores some solar energy.

The kinetic energy in the atmosphere in the form of wind has been estimated to be about 1/60th of a SERPY (2.6×10^{13} Mwh.) per year; it, too, is stored energy, but it is small in comparison to the solar energy received.

Although the ocean — and the atmosphere, too, for that matter — receives some heat from the earth's interior, the bulk of the ocean's heat is acquired from the sun, and it represents a very large amount of stored energy — some 146 SERPYS (2.2×10^{17} Mwh.). In addition to heat, the ocean also contains energy in its currents — which arise partly from the Coriolis force, partly from the wind, and partly from gravitational tidal forces. The ocean also contains energy stored in its salinity, for (as Richard Norman pointed out in *Science* for October 25,

1974) the addition of fresh water to saline water is an exothermic reaction — one which yields heat. Ocean salinity is another example of a product — resulting from work performed by solar energy (in this case evaporation) — which has captured and stored some of the energy input. Sato points out that another way to look at this reaction is that the energy is stored in the fresh water resulting from the desalination of sea water by solar energy.

Solar energy, coupled with gravitational and the Coriolis forces (due to the earth's rotation), provides much of the drive for atmospheric and oceanic circulation and for the hydrologic cycle. Hence, solar energy is mainly the power also for the processes of weathering, erosion, and sediment transport. The annual waterpower energy totals only 1.7 millionths of a SERPY (2.5×10^9 Mwh.), but over geologic time the work expended by hydrologic processes has been enormous — mountains and continents have been eroded and base-leveled and sediments have been formed from weathered rocks and transported to the seas and oceans. In one way or another, solar energy is also responsible for the deposition not only of sediments made up of fragments of pre-existing rocks but of the sediments of organic origin and the great bulk of the chemical sediments, the precipitation of most of which depends on temperature, salinity, CO_2 content, or some other variable that is basically affected by solar energy.

Processes of erosion and sedimentation have involved a substantial redistribution of materials at the earth's surface. They have added to the load on the earth's crust beneath the thick accumulations in sedimentary basins and have lightened it in other places where once-high mountain ranges have been eroded away.

To what extent have this loading and unloading contributed to crustal dynamics? Ten or 15 years ago, when the geosynclinal theory was still in relatively good standing, some would have said that loading was in fact the drive for much of the geosynclinal process, which was thought to begin with the downwarping of the crust, to continue with subsidence resulting from the accumulation of a thick pile of sediments, and to result finally (for reasons not fully understood) in mountain building and uplift. Now, with the new concepts of plate tectonics, folded mountains are thought to be a part of the grander processes of plate movement and subduction. But the theory of isostasy — that crustal loads are supported buoyantly, as are icebergs in the ocean, with heavier loads riding more deeply — is still in good standing. A clear example of its operation — and with a solar energy drive —

Petroleum Resources: How Much Oil and Where?

was the depression of the crust in northern North America and Europe under the weight of the ice cap during the Pleistocene glaciation and the rebound that is still underway. I cannot answer my question about the extent to which crustal loading and unloading contribute energy to crustal dynamics, but my intuition tells me that it is substantial, whether or not it has been sufficient to change the course of processes driven by energy from within the earth.

While the amounts of solar energy stored in various forms are not impressive in terms of the 4.5 billion SERPYS received by the earth over its history, the amount of energy captured to perform work in weathering, erosion, sedimentation, evaporation, crustal loading and unloading, photosynthesis, and so on has been substantial. The sun has indeed been a dynamic agent in earth history.

Man's Use of Earth's Energy: A Trivial Fraction

Incidentally, Harold Jeffreys and other geophysicists long ago answered my initial question of how much energy is in the earth. The rotational energy of the earth is equal to 40,000 SERPYS (6.00×10^{19} Mwh.) and the original gravitational energy of the earth is equal to 41 million SERPYS (6.25×10^{22} Mwh.), much of which has been converted to heat and elastic energy. The heat generated from the decay of radioactive materials is about one ten-thousandth of a SERPY (1.6×10^{11} Mwh.) a year, and of course there is a huge potential in the nuclear energy yet to be generated. The total heat content of the earth is of the order of 5 million SERPYS, and the heat brought to the earth's surface from all sources and dissipated into the atmosphere amounts to about one seven-thousandth of a SERPY (2.3×10^{11} Mwh.) a year — only a tiny fraction of the total heat received from the sun. The relatively small heat flow to the surface is a misleading indication of the total energy being expended within the earth, for it does not reflect the enormous amount of work performed within the earth by physical and chemical processes.

Knowing of my involvement in energy source problems, I suppose many may suppose that my interest in earth energy arises from the possibility of recovering some of it for man's use. I will admit to having thought about that briefly; but the result did not generate any excitement about the prospects, especially for the near term. I am impressed, however, by the enormous amounts of energy involved in the sun-earth system — the amount reaching the earth from the sun, the amount of solar energy captured and stored in various forms, and the amount in the earth. Of all this, the energy being used by

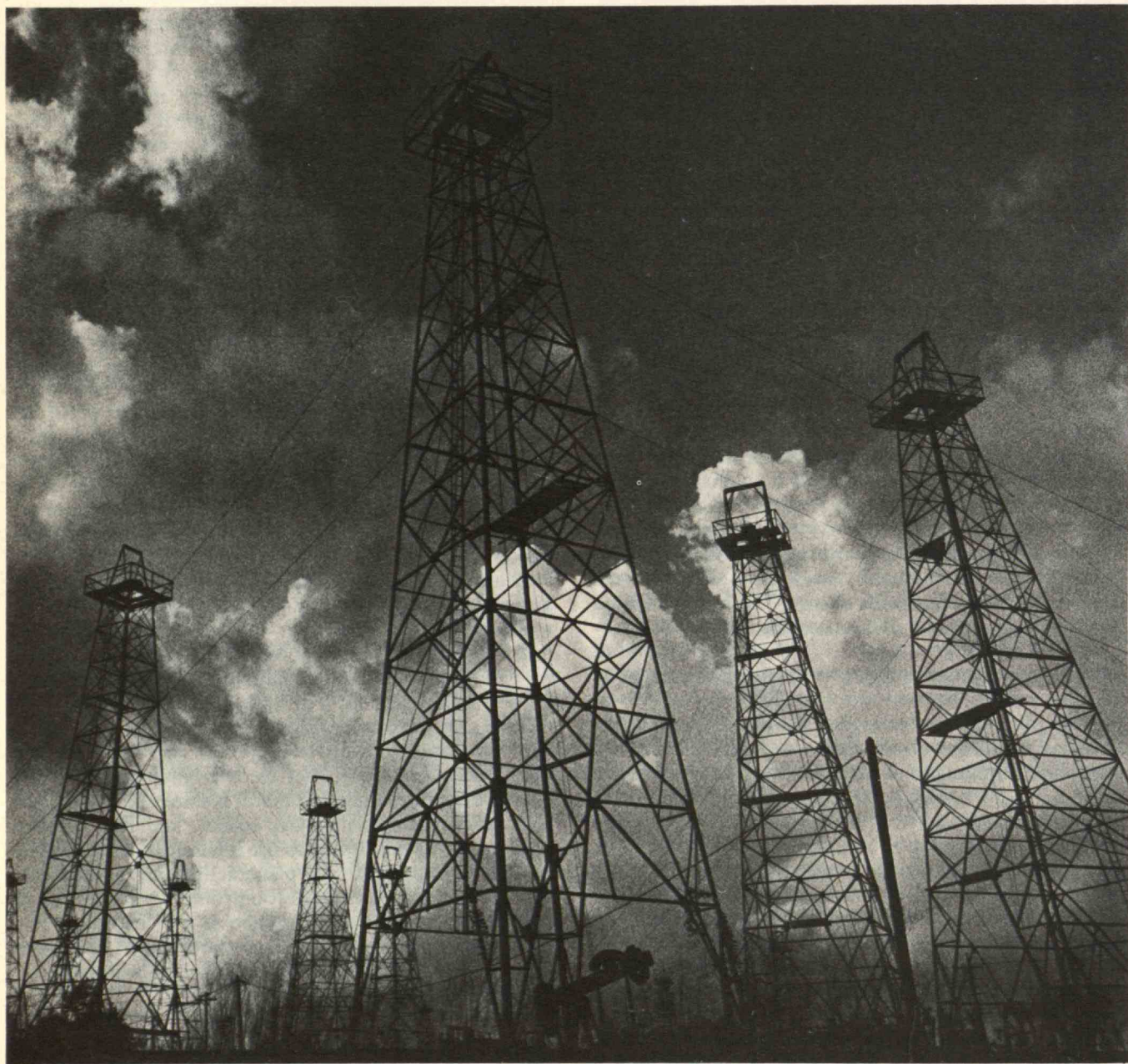
man is trivial, and the amount of heat being used from the solid earth is miniscule, for we have barely begun to recover either geothermal energy or energy from the atom. Certainly we will increase our capture and use of solar, geothermal, and — if we can overcome the technological and safety problems involved — nuclear energy as well — and there are exciting potentials in all of these areas. Possibly other means of capturing energy from the sun-earth system will suggest themselves in the future, but first we need to enlarge our understanding of the system itself. This applies not only to energy *per se* but to geologic processes driven by energy. Brian Mason (*Principles of Geochemistry*, New York: John Wiley and Sons, 1960) observed some years ago, in an excellent review of these processes, that whereas we usually consider the geochemical cycle in terms of the material changes that take place, the energy changes during the geochemical cycle are equally significant even if less well understood. "Geochemical processes," he said, "operate only because of a flow of energy from a higher to a lower potential or intensity; hence energy is no less important than matter in the geochemical cycle." The same can be said about physical processes.

Referring again to Frank Press' invitation to discuss the general subject of natural resources, I trust I have met his request on at least the aspect of generality. And I believe, too, that I have kept to the subject of natural resources, for it is, of course, the sun and the earth and their materials and energy that are our basic natural resources.

Several years ago, Kenneth Boulding, the economist, used the concept of Spaceship Earth to remind us that the earth is finite and that we are confined to it. Fair enough; but one might add that it is some ship, that it has an auxilliary external power source, and that the first challenge to us in learning to use it wisely is to understand it. This is what earth and planetary science is all about, and the new wave of exploration could not have come at a more propitious time. As much as any institution and more than most, we can count on the Ida and Cecil Green Center for Earth Sciences to help propagate this wave into new and fruitful ground.

Vincent E. McKelvey joined the U.S. Geological Survey in 1941, shortly after completing undergraduate (1937) and Master's (1939) degrees in geology at Syracuse University and the University of Wisconsin, and he later completed his Ph.D. at Wisconsin, (1947). A distinguished economic geologist, he has been Director of the Survey since 1971. Dr. McKelvey acknowledges with appreciation the assistance of Bernardo Grossling and Motokai Sato of the U.S.G.S. in supplying many of the calculations he presents.

The U.S. has passed its peak of petroleum production — and also the point of no return in the development of effective synthetic substitutes by the year 2000.



As we become more and more dependent on petroleum, we are suddenly aware that we know with only modest certainty the total of petroleum resources which may ultimately be found in the U.S. and in the world. And we find ourselves equally powerless to

organize the resources of technology and capital by which our future dependence on crude oil can be reduced. (Photo: Owen D. Franken from Stock, Boston)

John D. Moody
Petroleum Consultant

Robert E. Geiger
Mobil Oil Corp.

Petroleum Resources: How Much Oil and Where?

Based on our present knowledge of resources, the total energy potentially available to us in the foreseeable future in the form of petroleum and natural gas — that is, the readily available hydrocarbons — amount to only six per cent of what we think of as potential energy in the world. The total energy available in coal and uranium far overshadows that which we can now foresee from oil and gas, and the former have to be the resources on which we will be depending primarily in the future.

With how much oil and gas is the world endowed? The answer to that question has three components:

— That part of the total resource base which has been produced, an amount which we can measure reasonably accurately.

— That part which has been discovered but not produced, an amount we can estimate on the basis of a lot of experience in straight reserve estimation.

— That part of the total that is undiscovered.

The latter is the really critical challenge — to gain some understanding of how much undiscovered oil and gas there may be on earth.

We recognize five different methods for estimating the amount of recoverable, undiscovered oil and gas.

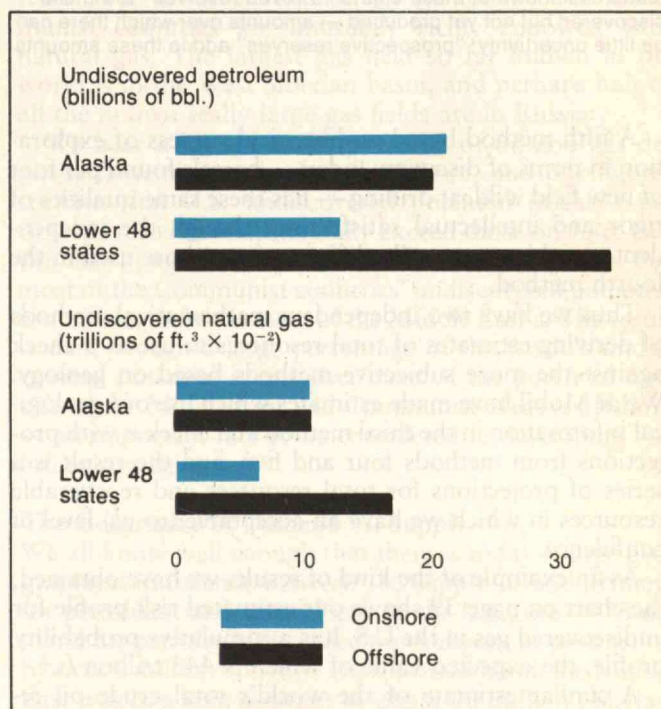
One can measure by various means the total volume of sediments available of the type in which oil and gas are likely to exist and then apply factors to suggest the proportion of these sediments which will hold oil and gas pools and the proportion of these resources which is likely to be recoverable.

Another method is based on geologic parameter analysis — an attempt to isolate and analyze in relation to known productive situations as many independent geologic variables as possible that may be pertinent in the accumulation of oil and gas fields. In struggling with this one, we at Mobil Oil Corp. identified some 160 presumed independent variables. But geologic variables are rarely independent; they are all interlocked in some way, and we found that relating as many as 160 separate geologic variables to known production was pretty difficult.

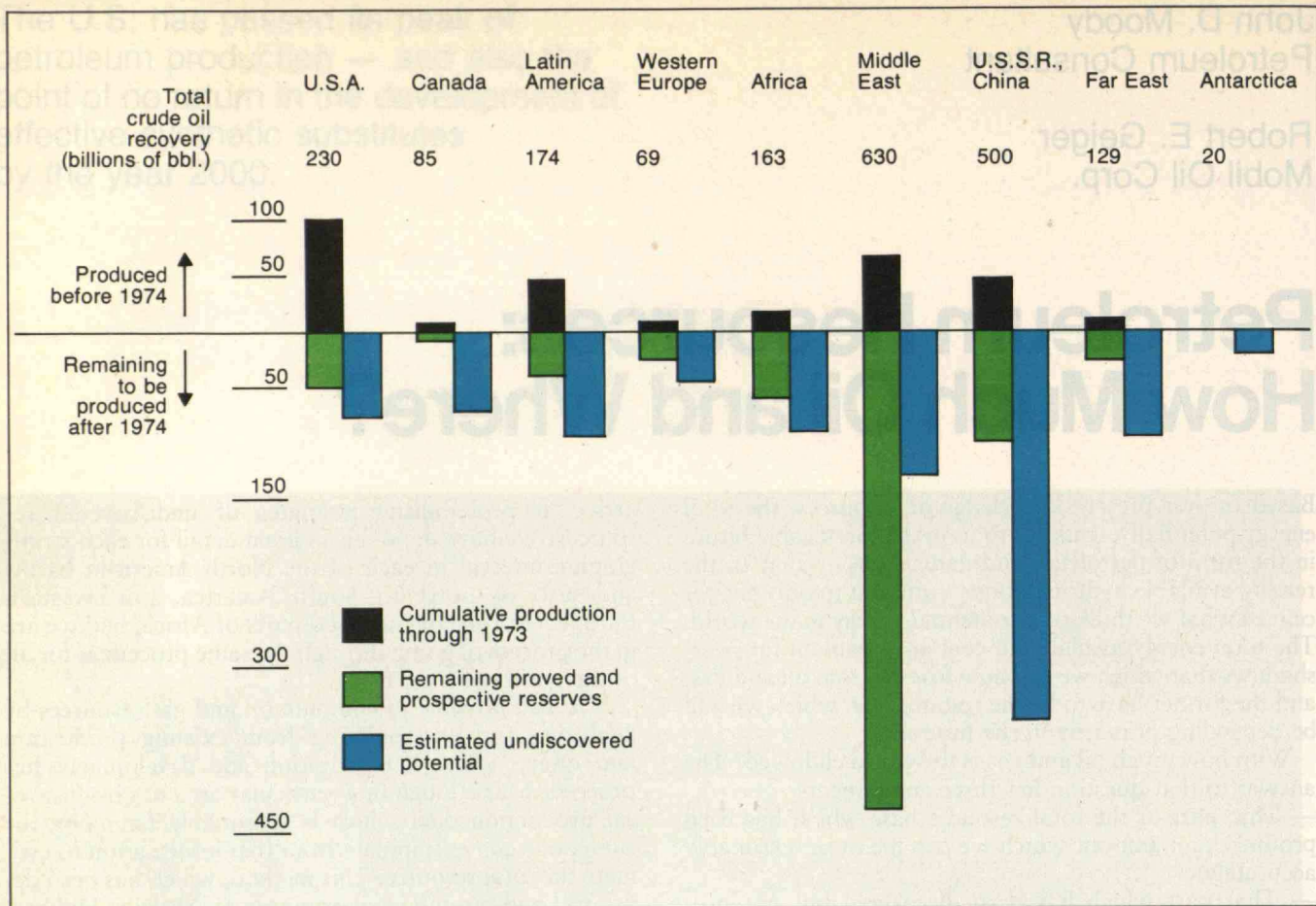
So we abandoned this procedure in favor of a third method, which we call the probabilistic exploration-engineering analysis. In this procedure, we take the ordinary equation for estimating discovered reserves of oil and gas and adapt it to apply to undiscovered oil and gas on a basin-wide basis and play-by-play, using estimates of independent variables not as single values or ranges but as probability distributions. We have developed computer programs based on Monte Carlo simulations to combine probability distributions, and on this basis we can

arrive at probabilistic estimates of undiscovered resources. We have done this in great detail for each stratigraphic interval in each of the North American basins and also in northern South America, northwestern Europe, the Persian Gulf, and parts of Africa, and we are in the process of going through the same procedure for all of the basins of the world.

It is also possible to compute oil and gas resources by analyzing and extrapolating from existing production and reserve data. If exploration and development has proceeded far enough in a particular area to give historical production data which is reasonably far along the curve, one can extrapolate from that information to estimate the total resource. This method, which has been developed and promulgated primarily by M. King Hubbert of the U.S. Geological Survey, is mathematically rigorous and intellectually satisfying.



According to the authors' estimates, most undiscovered recoverable resources of petroleum and natural gas in the U.S. will be found offshore; in contrast, most such resources in the Middle East and in the Communist countries will lie onshore. Because development costs are likely to be very different offshore and onshore, the authors propose that this is "an important fact to be considered in developing our future strategies."



Using methods described in the text, the authors have reached the estimates of total crude oil (above) and natural gas (opposite) resources shown in these charts. "Proved reserves" are those discovered but not yet produced — amounts over which there can be little uncertainty; "prospective reserves" add to these amounts

a component based on extensions to perceived fields and improved recovery techniques; together, write the authors, "proved reserves" and "prospective reserves" represent a total of resources "known or almost certain to become available."

A fifth method based on historical success of exploration in terms of discovery index — barrels found per foot of new field wildcat drilling — has these same qualities of rigor and intellectual satisfaction, though the independent variables are totally different from those used in the fourth method.

Thus we have two independent mathematical methods of deriving estimates of total resources to use as a check against the more subjective methods based on geology. We at Mobil have made estimates which use our geological information in the third method and check it with projections from methods four and five, and the result is a series of projections for total resources and recoverable resources in which we have an acceptable (to us) level of confidence.

As an example of the kind of results we have obtained, the chart on page 39 shows our estimated risk profile for undiscovered gas in the U.S. It is a cumulative probability profile, the expected value of which is 443 trillion ft.³

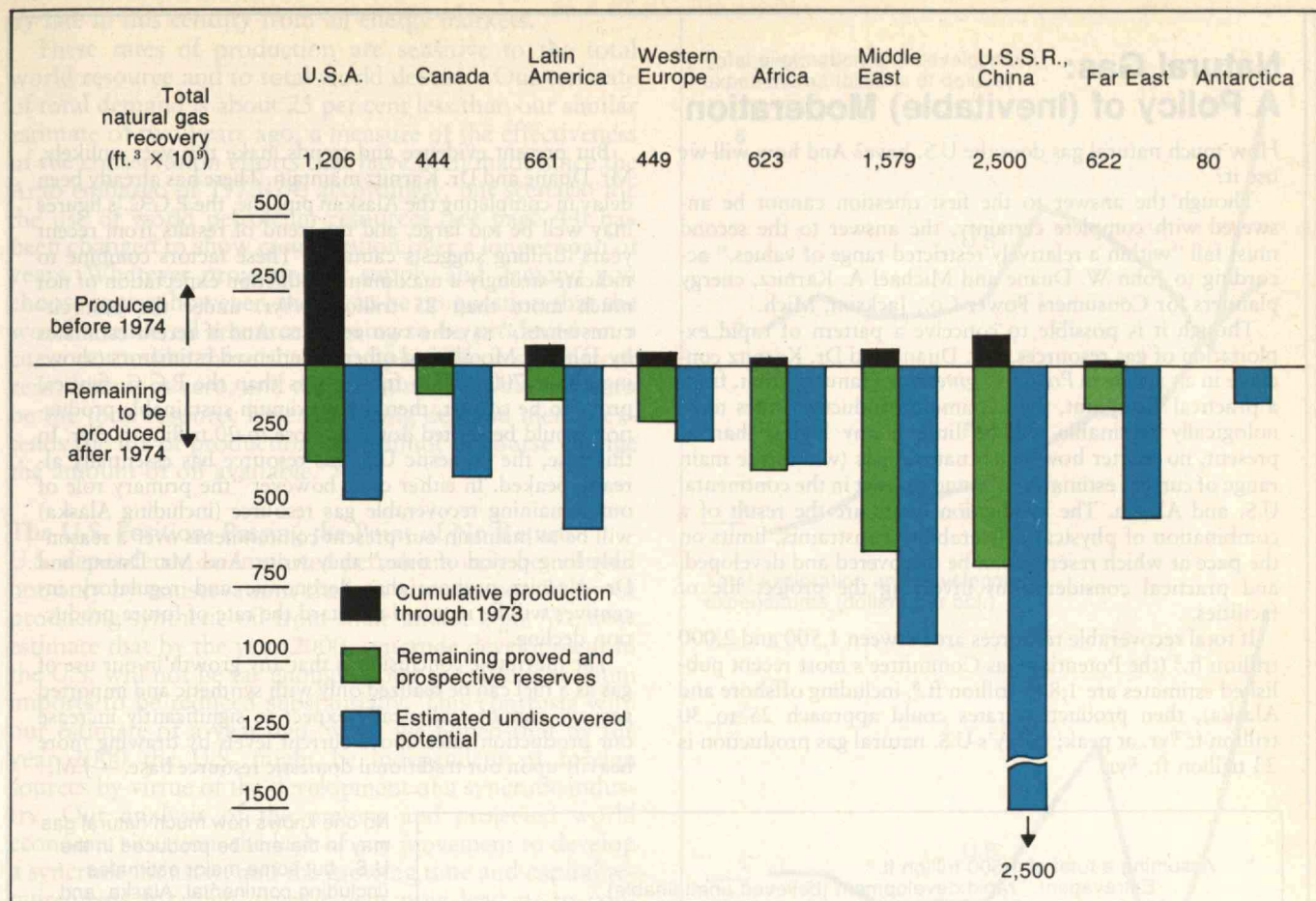
A similar estimate of the world's total crude oil resource base — the sum of all the figures in the chart on this page — yields a total of 2 trillion bbls. The 90 percentile and the 10 percentile give as a range 280 million to 2.2 trillion bbls.

Most of the numbers for unproduced reserves that one ordinarily sees published are what are called "proved reserves" — reserves that have been discovered but not

produced and concerning whose existence there is very little question; they are in fact numbers upon which a banker will lend money. However, in every oil field there is more potentially recoverable oil in the ground than is contemplated in estimates of proved reserves (largely in the form of extensions to the perceived size of the field and increments due to improved recovery); we call this component of discovered oil "prospective reserves," and we have estimated this in the case of all the oil fields in the world. Adding "proved reserves" and "prospective reserves" yields a number for discovered reserves (the green bars in the chart) which is the total of oil known or almost certain to become available. For example, for the U.S. we suggest proved and prospective reserves of 51 billion bbl., which compares to the figure of 33 to 35 billion bbl. that is usually published as the proved petroleum reserves of the U.S.

Summing this total with the potential resources derived in the computer-based analyses described above brings us to the figures in the chart at the top of this page — the total estimated recoverable oil.

This is not oil in place but recoverable oil, for this figure contemplates an overall recovery factor of about 40 per cent. We are familiar with oil pools from which we can recover 90 per cent of the hydrocarbons. This is the case, for example, in some of the fields in the Rainbow Lake area of Alberta, where we are dealing with forma-



tions into which we can inject petroleum-based chemical solvents and recover nearly all of the available hydrocarbons. On the other hand, there are many fields in which the oil is heavy and the formations are tight; some of these situations are intractable, and we will be fortunate to recover 15 per cent of the petroleum. In making our forecast, we have tried to anticipate the effect of improvements in recovery technology that we can reasonably predict. The result is an estimate of total recoverable petroleum throughout the world of 2 trillion bbls.

Another "Middle East" in Asia?

Where is this resource located in the world? We estimate that the Middle East has 630 billion bbls., of which almost 500 billion bbls. have been discovered but only a relatively small amount produced so far. Russia and China are estimated to have 500 billion bbls., with a range of uncertainty (90 percentile and 10 percentile) from 100 to 900 billion bbls. Only 150 billion bbls. of Russian and Chinese petroleum potential are presently discovered, and of this production to date has been only 46 billion bbls. (*For a Soviet view of U.S.S.R. resources, see "Soviet Energy: An Internal Assessment," by Marianna Slocum, Oct./Nov., pp. 16-33.*)

Nowhere else in the world are there petroleum resources anywhere near the magnitude of those that we estimate for the Middle East and for the Communist countries. And the estimated 350 billion bbls. of petroleum still undiscovered in Russia and China is the largest number in that category by far. Our knowledge of the petroleum geology of the world is such that we can assert with some assurance that if there is another Middle East in the world, the chances are it is in Western Siberia.

Our figures suggest that the world's natural gas is distributed in a similar fashion (chart above). The Communist countries are unusually richly endowed with natural gas. The largest gas field so far known in the world is in the West Siberian basin, and perhaps half of all the known really large gas fields are in Russia.

We hear a lot about the potential of oil and gas deposits remaining to be found offshore, and our figures confirm that U.S. undiscovered potential offshore petroleum resources substantially exceed those onshore (see the chart, page 39); and the same is true for Canada. But most of the Communist countries' undiscovered potential is onshore, and so is most of the Middle East's. The result is that, though a large percentage of the world's undiscovered potential is onshore, most of the potential outside of the Middle East and Communist areas is offshore — an important fact to be considered in developing our future strategies.

The Geography of Demand vs. Supply

We all know well enough that there is today a large geographical imbalance between the supply of and demand for petroleum and natural gas. In the U.S., our 1973 demand for petroleum exceeded our indigenous production by over 6 million bbl./day. On the other hand, the Middle East was in a long position by about 20 million bbl./day. In general, the same situation now exists for natural gas; the U.S. is importing gas from Canada, and we will be importing liquefied natural gas (LNG) from overseas in the future. Indeed, it is clear that the U.S. is rapidly using up its share of the world's hydrocarbons and must in the future call on other countries to a greater and greater extent.

Natural Gas: A Policy of (Inevitable) Moderation

How much natural gas does the U.S. have? And how will we use it?

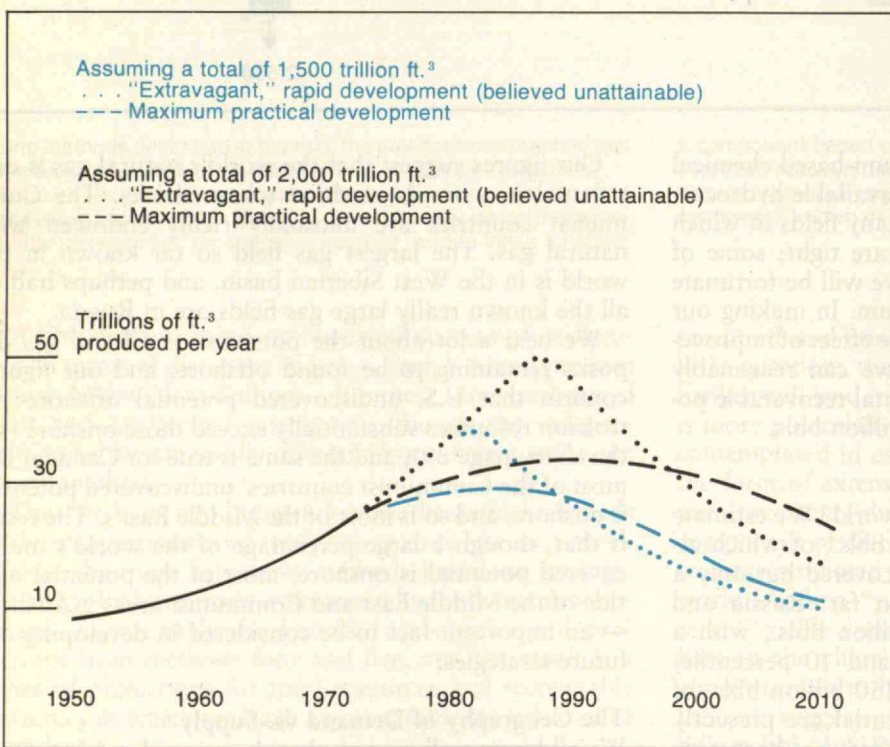
Though the answer to the first question cannot be answered with complete certainty, the answer to the second must fall "within a relatively restricted range of values," according to John W. Duane and Michael A. Karnitz, energy planners for Consumers Power Co., Jackson, Mich.

Though it is possible to conceive a pattern of rapid exploitation of gas resources, Mr. Duane and Dr. Karnitz conclude in an article in *Power Engineering* (January) that, from a practical viewpoint, the maximum production rates technologically attainable will be little if any higher than at present, no matter how much natural gas (within the main range of current estimates) is found to exist in the continental U.S. and Alaska. The production limits are the result of a combination of physical deliverability constraints, limits on the pace at which reserves can be discovered and developed, and practical considerations involving the project life of facilities.

If total recoverable resources are between 1,500 and 2,000 trillion ft.³ (the Potential Gas Committee's most recent published estimates are 1,845 trillion ft.³, including offshore and Alaska), then production rates could approach 25 to 30 trillion ft.³/yr. at peak; today's U.S. natural gas production is 23 trillion ft.³/yr.

But present evidence and trends make this very unlikely, Mr. Duane and Dr. Karnitz maintain. There has already been delay in completing the Alaskan pipeline, the P.G.C.'s figures may well be too large, and the trend of results from recent years' drilling suggests caution. "These factors combine to indicate strongly a maximum production expectation of not much more than 25 trillion ft.³/yr. under the best circumstances," say the two analysts. And if recent estimates by John D. Moody and other experienced estimators (showing about 700 trillion ft.³ less gas than the P.G.C. figures) prove to be correct, then the maximum sustainable production would be shifted down to close to 20 trillion ft.³/yr. In this case, the domestic U.S. gas resource has essentially already peaked. In either case, however "the primary role of our remaining recoverable gas resource (including Alaska) will be to maintain our present commitments over a reasonably long period of time," they write. And Mr. Duane and Dr. Karnitz propose that "economic and regulatory incentives will be required to retard the rate of future production decline."

The inevitable conclusion is that any growth in our use of gas as a fuel can be realized only with synthetic and imported gas; we cannot realistically expect to significantly increase our production rates above current levels by drawing more heavily upon our traditional domestic resource base. — J.M.



No one knows how much natural gas may in the end be produced in the U.S., but some major estimates (including continental, Alaska, and offshore resources) range between 1,500 and 2,000 trillion ft.³. On the question of how these resources are exploited depends their useful lifetimes — and their cost. To John W. Duane and Michael A. Karnitz, Staff Engineers at Consumers Power Co., the lower, "moderate" scenarios sketched above are the maximum production that may be expected under even the best of conditions.

Measured in percentages, Western Europe, including the North Sea, is far more dependent than the U.S. on imported oil; its consumption of 27 per cent of the world oil contrasts with the 4 per cent of world resources that Western Europeans control. Japan has no substantial amounts of hydrocarbons to fill its projected needs, while the Communist countries are relatively in good shape.

At what rates will the world's petroleum resource base be produced? U.S. crude oil production has peaked; we are unlikely to produce as much petroleum and natural gas in any year in the future as we have in the past, and

the share of the world's total crude oil needs to be obtained from the U.S. and Canada — including undiscovered as well as discovered resources — will be lower in the future than in the past. In Canada, the production peak will come in a few years, certainly by 1985. The Middle East will provide 630 billion bbls. to the world's crude oil resource base; and we estimate that production in the Middle East will peak in about 1995. From the Communist countries will come a total of 500 billion bbls. of oil, and that peak will occur probably before the year 2000 because of the heavy pressure which will be felt

by late in this century from all energy markets.

These rates of production are sensitive to the total world resource and to total world demand. Our estimate of total demand is about 25 per cent less than our similar estimate of two years ago, a measure of the effectiveness of the conservation efforts that have been made since the Arab embargo of 1973-74; accordingly, our scenario for the use of world petroleum resources (see page 44) has been changed to show consumption over a longer span of years. Whatever projection of supply and demand you choose to use, however, there can be no question that the world's crude oil resource is going to be produced on a curve not unlike those shown on page 44; it starts from zero, it ends at zero, and the area under the curve has to be the total resource base. Reducing demand merely extends the life of production and cannot of course change the amount of oil available.

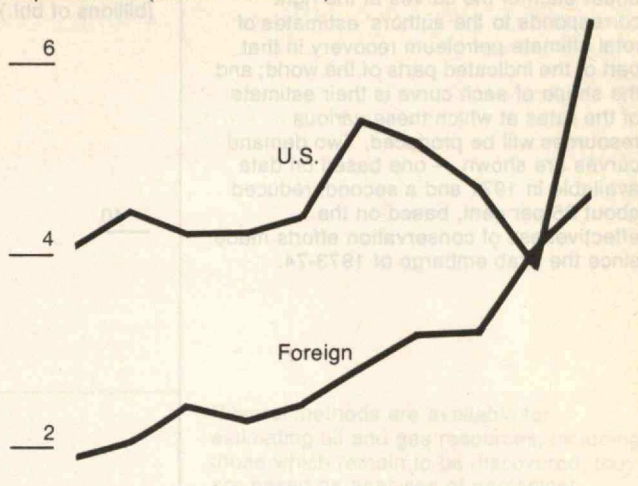
The U.S. Position: Passing the Point of No Return

U.S. dependence on imported petroleum may be reduced not only by conservation; there is also the possibility of producing synthetic oil from shale and/or coal. We now estimate that by the year 2000, syncrude development in the U.S. will not be far enough along to cause petroleum imports to be reduced substantially. This contrasts with our estimate of a year ago, when we hoped that by the year 2000 the U.S. might be independent of foreign sources by virtue of the development of a syncrude industry. Our analysis of the present and projected world economic situation, the lack of any movement to develop a syncrude industry, and the growing time and capital requirements for such development now lead us to conclude that the U.S. has already passed the point of no return — that we cannot build a syncrude industry in time to become independent of foreign crude by the year 2000.

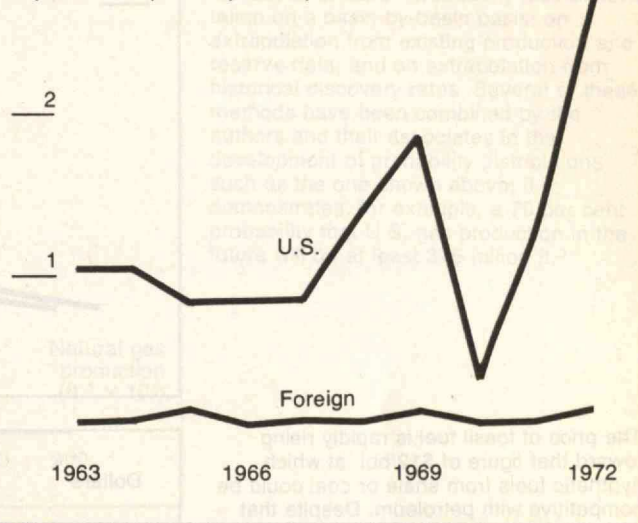
The U.S. petroleum industry has been averaging about \$5 billion per year of capital investment for exploration and development in the previous 12 years. In order to achieve the oil and gas production rates that are implicit in the projections made above, the U.S. industry, effective almost at once, is going to have to invest almost \$13 billion per year in 1974 dollars. It is not generally recognized that the oil industry is today making almost twice as much capital investment in the U.S. as it is overseas.

This is one way of demonstrating that replacing reserves in the U.S. costs far more than it does overseas. As we begin to depend more heavily on imported petroleum, we can assume that more and more of our capital investment will be made overseas. But this approach neglects one important alternative, which is made clear by data comparing world energy resources of all types. The fact is that, if you consider uranium, coal, and oil shale as well as petroleum, the U.S. is really well endowed in total energy. Indeed, North America has 40 per cent of the world's known heavy oil resources (including the Canadian tar sands), 24 per cent of the world's coal resources, and 67 per cent of the world's shale oil resources. The fact is that we are really not strapped, that we simply have to move far more aggressively than we have to date to develop those resources, technologies, and industries which can give us fuel and energy to substitute for the diminishing crude oil and natural gas resource. The fact that we have failed to begin significant domestic investments in the past two years is one reason why we have changed our projections to say that the U.S. will not have a syncrude industry that will remove our dependence on

Total exploration and development expenditures (billions of dollars)



Total exploration and development expenditures (dollars per bbl.)

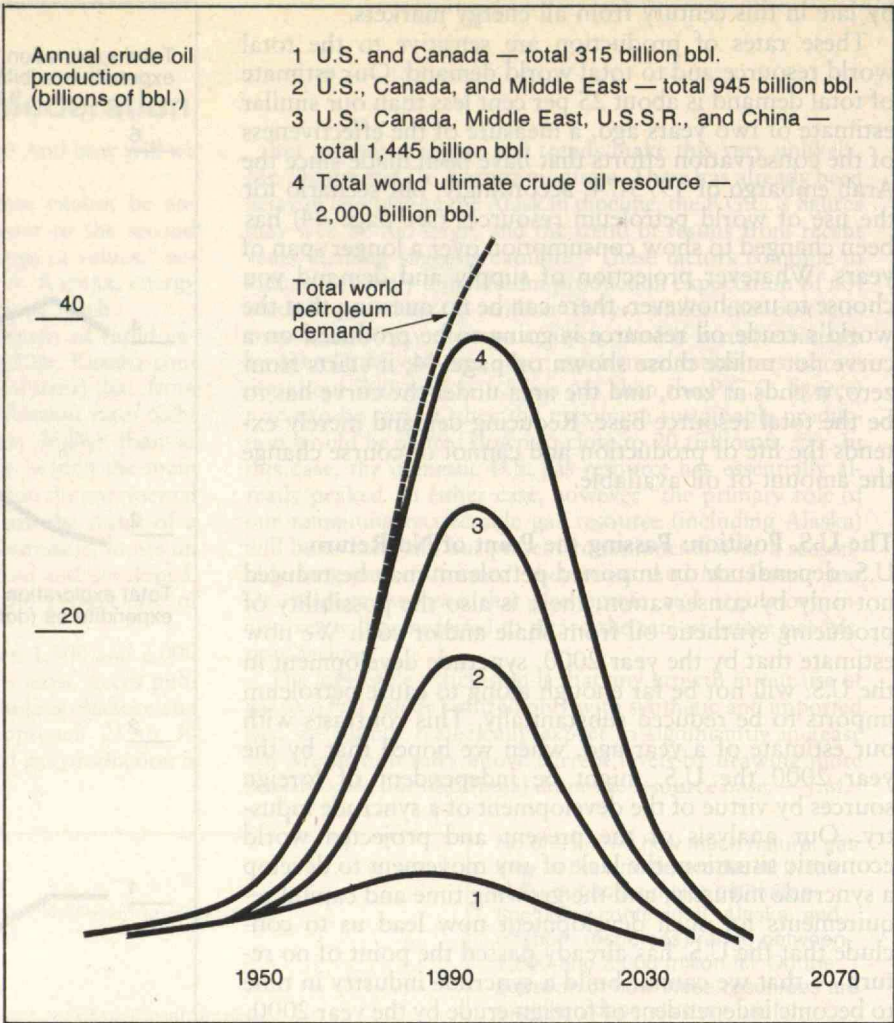


The cost of finding and developing new petroleum resources in the U.S. is rapidly outstripping that in other nations, and the trend will continue as we become more and more dependent upon offshore resources. In order to achieve the authors' projected production of oil and gas, the U.S. must invest — beginning at once — some \$13 billion annually in 1974 dollars; our only alternative is increasing dependence on foreign petroleum and therefore increasing outflows of U.S. funds.

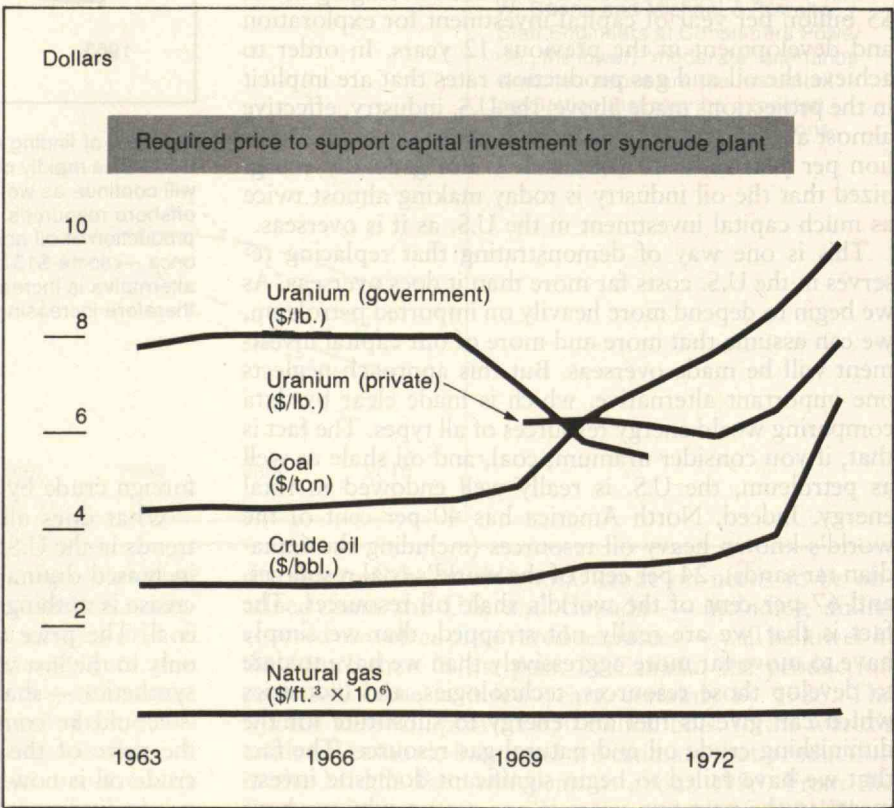
foreign crude by the year 2000.

What does all this have to say for future fuel price trends in the U.S.? We all know that crude oil prices have increased dramatically in the last two years; but this increase is nothing compared to the increase in the price of coal. The price of natural gas has really started to rise only in the last year. We have said in the recent past that synthetics — shale oil and crude or natural gas from coal — could be competitive with conventional crude when the price of the latter reached the range of \$12/bbl. If crude oil is now selling at almost those prices, why isn't private industry rushing to build up the syncrude business? The answer is simple: the uncertain legislative environment in which those industries may be forced to oper-

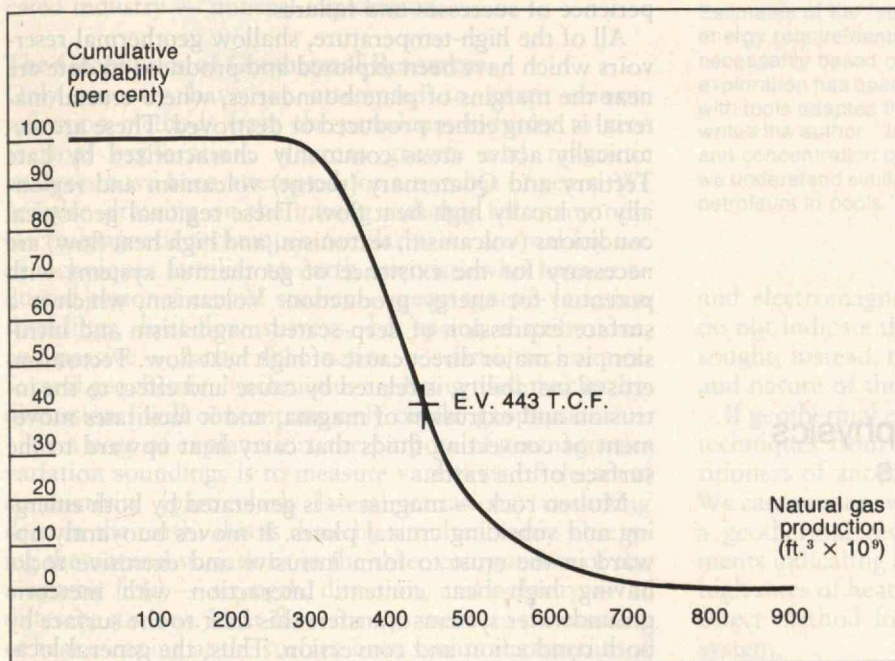
Every curve for the utilization of the world's crude oil resource has the same shape: It starts at zero and ends at zero. The area under each of the curves at the right corresponds to the authors' estimates of total ultimate petroleum recovery in that part of the indicated parts of the world; and the shape of each curve is their estimate of the rates at which these various resources will be produced. Two demand curves are shown — one based on data available in 1971 and a second, reduced about 25 per cent, based on the effectiveness of conservation efforts made since the Arab embargo of 1973-74.



The price of fossil fuel is rapidly rising toward that figure of \$12/bbl. at which synthetic fuels from shale or coal could be competitive with petroleum. Despite that fact, the research and development necessary for a syncrude industry is not progressing, and the authors conclude that "the U.S. has already passed the point of no return — that we cannot build a syncrude industry in time to become independent of foreign crude by the year 2000." Why? Because of "government indecision and even punitive decisions," write Messrs. Moody and Geiger.



Robert E. Geiger, Manager of Evaluation and Analysis in Mobil's Exploration and Producing Department



Several methods are available for estimating oil and gas resources, including those which remain to be discovered; they are based on analyses of geological formations throughout the earth in which oil is likely to exist; on probability distributions taken on a basin-by-basin basis; on extrapolation from existing production and reserve data; and on extrapolation from historical discovery rates. Several of these methods have been combined by the authors and their associates in the development of probability distributions such as the one shown above; it demonstrates, for example, a 70 per cent probability that U.S. gas production in the future will be at least 375 trillion ft.³

ate. Punitive legislation is pending in Congress, and nobody can know whether those prices will in fact enable a syncrude industry to be built and be profitable. Legislation passed in Canada has resulted in Shell Oil Co. abandoning its development of the Athabasca tar sands; the economic environment in Canada is such that Shell had to decline to invest.

On the basis of today's technology, a minimum size viable coal liquefaction plant must produce about 100,000 bbls./day. The capital investment required is about \$10,000/bbl./day of crude oil; that means a \$1 billion investment for a coal liquefaction plant to produce 100,000 bbls./day. Compare this with today's consumption of 17 million bbls./day and with President Ford's goal to reduce imports by 1 million bbls./day. To replace those 1 million bbls. of oil would require ten of those plants, a \$10 billion capital investment. Oil from shale or from tar sands also requires about \$1 billion investment for 100,000 bbls./day. Coal gasification plants appear to be approximately twice as expensive. But in the Middle East, Libya, and Nigeria, crude oil increments can now be added at costs ranging from \$300 to \$2000/bbl./day, depending on location. In the North Sea, new oil can be reached for \$2,800 to \$3,200 per daily bbl.; in the U.S., new offshore oil can be added for \$5,000 to \$8,000/bbl./day. (There

are two reasons for the high cost in the U.S.: The productivity of wells in the U.S. is considerably lower than the productivity of those in foreign areas; and the federal government imposes severe economic inhibitors.)

To summarize: Any thoughtful analysis of petroleum-based energy resources shows the U.S. in a weakened position and moving into a worse position for the future. World petroleum resources may last into the early years of the 21st century, but U.S. resources will be substantially exhausted well before then. Though it is essential to continue to invest relatively modest sums to increase overseas petroleum production immediately, our obvious course is to make the more substantial investments in new technology and in a new syncrude industry which will enable us to capitalize on the generous fossil resources with which North America is endowed. Government indecision and even punitive decisions are unnecessary deterrents to this urgent, vital effort.

John D. Moody, whose estimates of petroleum supply and demand are widely respected throughout the industry, was Senior Vice President of Mobil Oil Corp. at the time of his retirement last year; he is now a consultant in the field. **Robert E. Geiger** is Manager of Evaluation and Analysis in Mobil's Exploration and Producing Department.

The Geology and Geophysics of Geothermal Energy

James B. Combs
Associate Professor of Geophysics
University of Texas at Dallas

Geothermal energy sources can be detected using methods adapted from mineral and petroleum exploration. But our knowledge of geothermal exploration techniques, origins, and resource size is still extremely primitive.

The world's first geothermal wells were drilled in Italy in the late 1820s. United States exploitation of geothermal energy began in the late 1920s in California. Both the early Italian drilling and the drilling in the United States were based on surface manifestations of heat — hot springs, geysers, and fumaroles. It is clear that other geothermal resource areas can be developed; however, we must learn more about how to detect these reservoirs and where to select potential drilling sites. The exploration approach to geothermal energy involves an integrated and coordinated program of the application of many geological, geophysical, and geochemical techniques, basically similar to oil and gas exploration or to the exploration for mineral deposits to yield metallic ores. However, the science and technology of the development of geothermal resources is young and untested by a long experience of successes and failures.

All of the high-temperature, shallow geothermal reservoirs which have been explored and produced to date are near the margins of plate boundaries, where crustal material is being either produced or destroyed. These are tectonically active areas commonly characterized by Late Tertiary and Quaternary (recent) volcanism and regionally or locally high heat flow. These regional geological conditions (volcanism, tectonism, and high heat flow) are necessary for the existence of geothermal systems with potential for energy production. Volcanism, which is a surface expression of deep-seated magmatism and intrusion, is a major direct cause of high heat flow. Tectonism, crustal instability, is related by cause and effect to the intrusion and extrusion of magma, and it facilitates movement of convecting fluids that carry heat upward to the surface of the earth.

Molten rock — magma — is generated by both emerging and subsiding crustal plates. It moves buoyantly upward in the crust to form intrusive and extrusive rocks having high heat content. Interaction with meteoric groundwater systems transfers this heat to the surface by both conduction and convection. Thus, the general location of geothermal systems is determined by the location of deep igneous masses that provide the probable heat source driving the overlying convective meteoric groundwater system. The rock units which happen to occur above these heat sources have no value in predicting their potential. In other words, the heat source superimposes an anomalous temperature regime, a geothermal system, on the upper few kilometers of crustal material, regardless of its age or mode of formation — whether it is of sedimentary, igneous, or metamorphic origin. This is in sharp contrast to petroleum reservoirs, which are intimately associated with sedimentary environments.

The nature of a geothermal system, however, is strongly dependent on the physical characteristics — for example, porosity and permeability — of the reservoir rocks. In addition, the geometry of the convecting groundwater system, which serves as part of the geothermal system and brings heat from the source to the surface, can be significantly influenced by the structural and stratigraphic detail in the upper few kilometers. Hot water rises buoyantly up the path of least impedance. This need not be vertical, and in fact plumes of hot water can be displaced laterally from their heat source by as much as several kilometers, an occurrence which further complicates the exploration for geothermal systems.

The objectives of any geothermal exploration, then, are

to locate areas underlain by hot igneous masses; to estimate the volume, temperature, and permeability of the overlying rocks; to predict whether wells drilled to a specified depth will produce dry steam or a mixture of hot water and steam; and to predict the chemical composition of the produced fluids.

For fulfilling these objectives, we lack a highly specific method such as seismic reflection provides for the petroleum industry. Many of the techniques useful in finding geothermal resources are those of the mining industry. This is a curious anomaly, since to date the development of geothermal energy has been carried on primarily by people trained in the petroleum industry. Therefore, one highly sophisticated industry — petroleum — is trying to use techniques which are primarily developed for, and known in, another equally sophisticated industry — mineral exploration.

The Geophysics of Geothermal Resources

Only recently have we attempted to adapt seismic reflection methods from the petroleum industry to geothermal exploration, whereas gravity and magnetic analyses have been attempted for a number of years. We are also drawing on the mining industry for many new electromagnetic techniques. Similarly, we are making use of techniques familiar to earth scientists who have conducted regional crustal studies — geomagnetic-variation soundings, heat-flow surveys, hot-spring distributions, and passive — rather than active — seismic techniques. Several geochemical techniques are being used, but in this discussion I will concentrate only on the geophysics.

As a note of explanation, the purpose of geomagnetic-variation soundings is to measure variations of electrical conductivity (particularly lateral variations) occurring deep in the earth; this is done by simultaneously observing the natural variations in the three components of the magnetic field — strength, direction, and polarity — at different stations. Heat-flow surveys measure the amount of heat escaping at the surface from within the interior of the earth; to determine terrestrial heat flow requires measuring the temperature gradient from the bottom to the top of a vertical borehole and the thermal conductivity of the rocks in which this temperature gradient was measured. Passive seismics involve recording local, microearthquakes of *natural* causes — this in contrast to active seismic techniques which are dependent on the use of explosions or other man-made devices to generate elastic waves. Most geothermal systems are characterized by abundant microearthquakes. Determining the precise location of these microearthquakes may aid in delineating fractured and permeable zones that provide conduits for the convecting plumes of hot water in geothermal areas. Another passive seismic method — seismic noise detection or geothermal noise detection — involves recording acoustic noise patterns within certain frequency ranges. These seismic noise measurements appear to provide a relatively simple method for detecting and mapping certain types of geothermal systems.

Some of the methods which I have listed above can be used to delineate geothermal reservoirs and furnish data on subsurface thermal processes. Most active seismic, gravimetric, and magnetic surveys are important in refining regional geological models and so indicate areas of possible interest, but they generally provide minimal information for precisely identifying and defining a geothermal reservoir. In contrast to thermal, electrical,

Year	Total number of wells drilled	
	Geothermal *	Oil and gas †
1970	10	29,467
1971	15	27,300
1972	25	28,755
1973	35	27,602
1974	50	28,000 est.

* Author's estimates
† Drilling statistics published annually in the Bulletin of the American Association of Petroleum Geologists

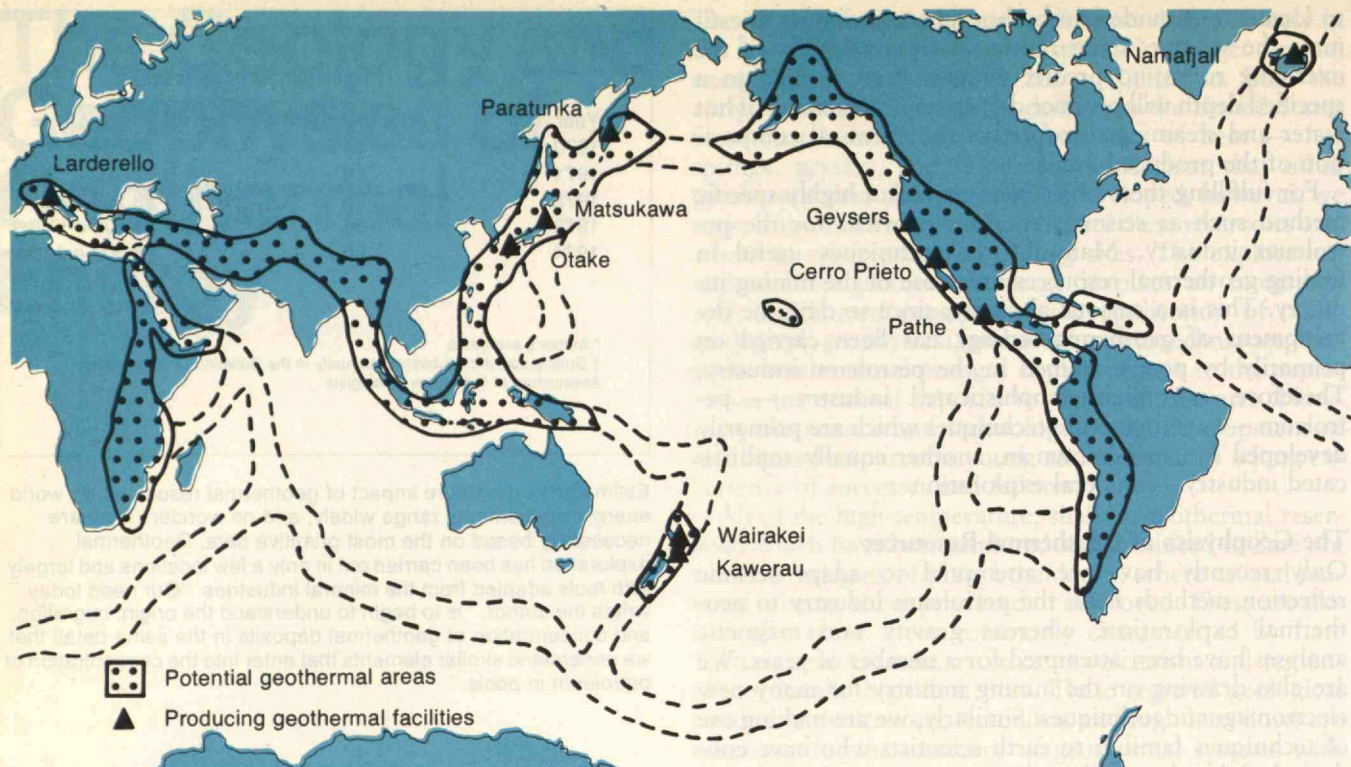
Estimates of the future impact of geothermal resources on world energy requirements range widely, and no wonder: They are necessarily based on the most primitive data. Geothermal exploration has been carried out in only a few locations and largely with tools adapted from the mineral industries. "Our need today," writes the author, "is to begin to understand the origin, migration, and concentration of geothermal deposits in the same detail that we understand similar elements that enter into the concentration of petroleum in pools."

and electromagnetic methods, these structural methods do not indicate the properties of the hot fluids which are sought; instead, they provide information on the attitude and nature of the host rocks.

If geothermal exploration is unique because it borrows techniques from one geophysical realm for use by practitioners of another, it is also unique in another respect: We can measure what we are looking for. The existence of a geothermal reservoir can be inferred from measurements indicating high temperatures at shallow depths and high rates of heat flow to the surface. Such data provide a direct method for assessing the extent of a geothermal system.

Geothermal reservoirs tend to be distinguished from surrounding ground by higher temperature, higher porosity, higher salinity of interstitial fluids, and/or greater content of clays and zeolites; consequently, the electrical conductivity in geothermal reservoirs is relatively high. Several electrical and electromagnetic methods which can be used to measure electrical resistivity at depth are therefore useful in searching for geothermal reservoirs. Most electrical techniques involve putting current into the ground at two electrodes and measuring the resultant potential at two other electrodes. Telluric and magnetotelluric methods are based on measuring variations in the natural electrical or electromagnetic fields. Electromagnetic methods involve generating a magnetic field that varies with time and detecting either the electrical or magnetic field arising from currents which are induced in the shallow subsurface.

Electromagnetic methods have been used in exploration only during the last five years. Although both instrumentation and interpretations are complex, they are preferred because they have two theoretical advantages over electrical methods: The signal size increases with decreasing resistivity or increasing conductivity, making measurements easier and more accurate in geothermal areas of interest than in non-target areas; and inductive methods — in contrast to electrical techniques — are not adversely affected by the near-surface zones of high resis-



The map of potential geothermal resources follows precisely the boundaries of the continental plates where molten rock can move upward through shattered crustal material. Geothermal resources are thus likely in many underdeveloped and developing countries which appear to have few other indigenous energy resources.

tivity which occur in many areas of the western United States where most of the geothermal resources appear to be located.

Despite the power of present methods for delineating geothermal reservoirs and furnishing data on subsurface thermal processes, we still have an express need for a rapid, low-cost, portable tool which will have penetration great enough to identify geothermal reservoirs. The presently produced geothermal reservoirs lie at depths between 1,500 and 2,500 m., with temperatures as low as 150° C. Very often there are no surface manifestations to give us clues to their presence at those depths.

Since each geothermal prospect represents a unique combination of geological, geochemical, hydrological, geophysical, technical, and financial characteristics, no one exploration technique suffices for all situations. Our need today is to begin to understand the origin, migration, and concentration of geothermal deposits in the same detail that we understand similar elements that enter into the concentration of petroleum in pools.

For example, recent work by my colleagues and myself suggests that repeated fracturing is needed in geothermal systems to provide conduits for the fluids which are the vehicle for heat transfer in the system. Such fluids rise from the hot, intrusive material below; because of their high temperatures, they take heavy burdens of minerals — particularly silica — into solution. As the geothermal fluids move up into the shallow zones, they cool and drop out these dissolved minerals; thus they gradually seal off

the permeable fractures and channels, forming impermeable zones or cap rock. The time frames (10^3 to 10^4 years) that are needed for continued turnover of the meteoric groundwater systems suggest that repeated fracturing is necessary to sustain geothermal flow. It is therefore likely that the techniques of earthquake seismology will be used more often in geothermal prospecting of the future.

Toward Advanced Geothermal Prospecting

Geothermal exploration is in fact still in the most primitive stage: We are in a stage similar to that of the petroleum industry in the 1930s and 1940s, when oil prospectors were drilling oil seeps — that is, we are doing little more today than drilling hot springs.

Many people working in the geothermal industry suggest one can predict the producing capacity of a geothermal system on the basis of some measurements of surface electrical resistivity, shallow temperature gradients, and/or heat flow. This simply is nonsense.

The discovery of a gravity anomaly confirmed by a seismic reflection anomaly does not provide the basic information necessary for calculating the petroleum reserves of a region, much less the petroleum resources. We have as yet no direct method of locating a pool of petroleum. At present, we know of no reliable, intrinsic physical property of underground petroleum that can be measured at the surface of the ground. Therefore, the approach of the petroleum geologist to the discovery prob-

lem must be indirect and is dependent on the information that can be obtained only from a borehole. Each pool is unique.

The same kinds of problems confront us in the exploration for geothermal systems that can be measured — notably temperature and electrical conductivity. However, the actual location and size of a deposit in the earth can only be determined by drilling exploratory wells into the geothermal system and producing the contents of the reservoir.

How Important Is Geothermal Energy, and To Whom?

What is the potential of our geothermal resources? Clearly that question is premature. As yet, there is no way of knowing the amount of geothermal reserves in the world or even in the United States. Since the 1920s, fewer than 1,000 intentional geothermal wells have been drilled throughout the world. Just over 125 geothermal wells have been drilled during the past five years in the United States. Fewer than 100 potential geothermal areas in the world have been explored to any extent, and many of these ventures have been inconclusive because of insufficient and misdirected efforts. We have negligible information upon which to estimate the potential of geothermal resources; no reliable estimate is possible.

What impact can geothermal resources have on the future energy requirements of the United States? In particular, what percentage of the electrical power needs of the United States could at some future time be provided by geothermal resources? We do not know. As can be seen in the table, at least 140,000 oil and gas wells (compared to approximately 130 geothermal wells) have been completed in the last five years. Yet despite this extensive exploration there remains a wide range of estimates of petroleum reserves published by a number of authors. How then can one realistically predict the impact of geothermal resources on our future energy requirements?

The estimates range from less than one per cent to as much as 100 per cent. But that is not the crucial question. I contend that future efforts to develop techniques for geothermal exploration and utilization should not be justified on the basis of the future electrical power needs of the United States that can be provided by geothermal energy. Geothermal energy may never provide more than five or ten per cent of the electrical power needs of the United States. However, this small percentage could have considerable impact on the American economy. For comparison, only four or five per cent of the electrical energy

in the United States has been, or will be, produced by hydroelectric installations. But consider the Pacific Northwest without hydropower; almost all of the power produced in Washington, Oregon, Idaho, and Northern California comes from hydropower.

We must develop our geothermal resources. But such development may be even more important for many developing and underdeveloped countries confronted by a shortage of fossil fuels — such as El Salvador, Kenya, the Philippines, Java, and others. For them geothermal energy may be the only indigenous energy resource. Most of these countries lack the necessary technical knowledge and manpower — not to mention the economic base — to explore for and develop geothermal energy resources. In the United States — where with six per cent of the world population we use 30 per cent of the world's natural resources — we have the scientific and engineering skills to provide for orderly and successful development of geothermal resources. Perhaps one way in which we may repay our debt to the world community for our sometimes frivolous and wasteful use of many of the easily recovered natural resources will be for us as scientists, engineers, and technicians to provide for these developing countries timely and efficient exploitation of geothermal resources. With the proper education and technology transfer, all nations could be afforded the opportunity of discovering and developing their indigenous geothermal resources.

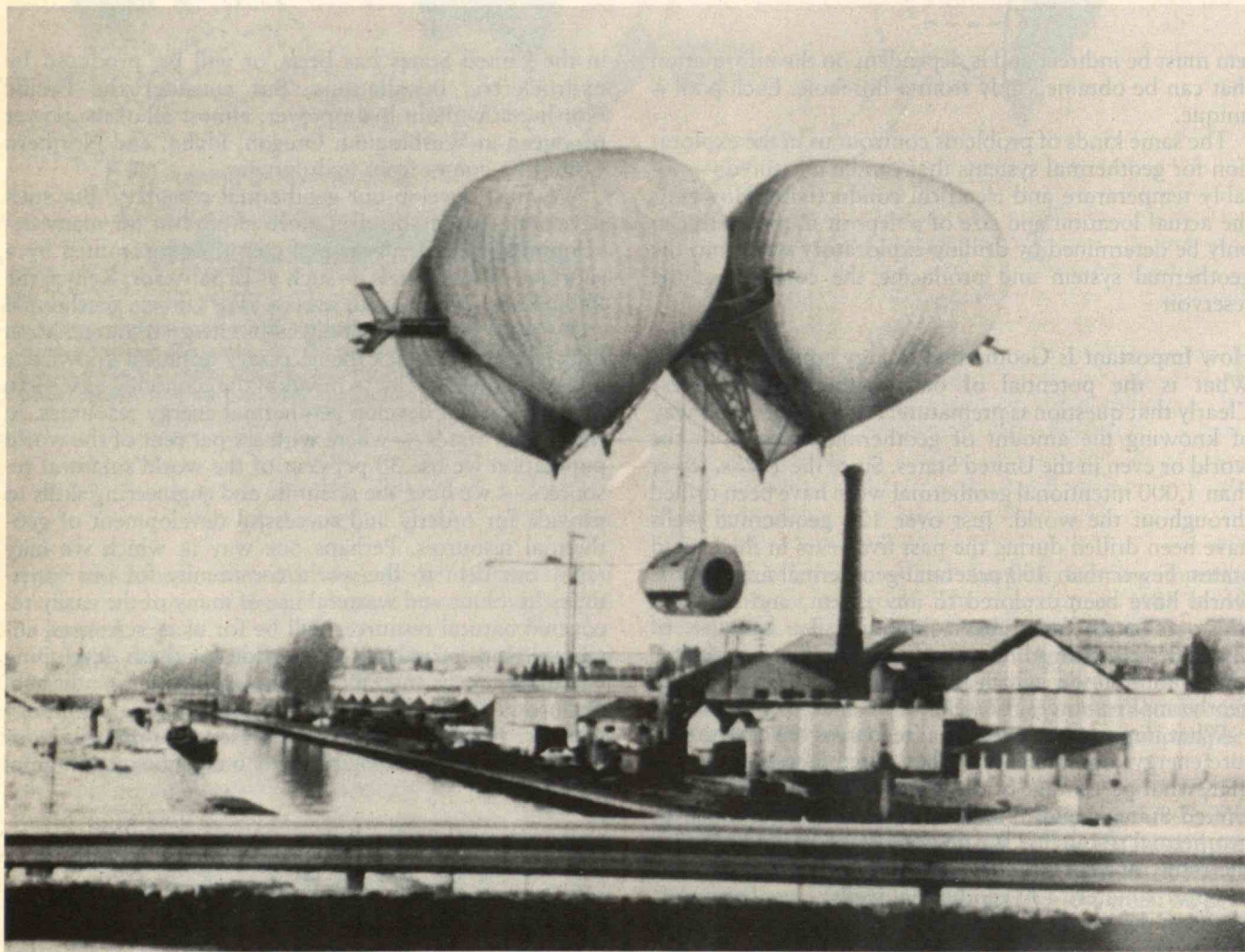
Suggested Readings

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Armstead, H. C. H. (editor), *Geothermal Energy: Review of Research and Development*, UNESCO Earth Sciences 12. New York: UNESCO, 1973.

Bowen, R. G., and E. A. Groh, "Geothermal — Earth's Primordial Energy," *Technology Review*, October/November, 1971, pp. 42-48.

James B. Combs has been engaged in geothermal research and exploration since 1968 and has published extensively in this field. A graduate of Southern Methodist University, Dr. Combs studied geophysics at M.I.T. (Ph.D. 1970) and taught at the University of California, Riverside, before taking his present post in 1974.



This giant aerial crane, unveiled recently in France, can hover or cruise at 50 m.p.h. with a load of 500 tons. Its four tear-shaped balloons are filled with helium and motors propel the craft horizontally with the load suspended beneath by cables. According to participants in the recent lighter-than-air conference in California, cargo-carrying will be the prime role for airships of the future. (Wide World Photo)

Trend of Affairs

Trends This Month

TRANSPORTATION 51

Dollars-and-sense on blimps, dirigibles, and balloons.

ENERGY 52

The energy efficiency of packaging ... Private money for publicity on atomic energy ... Energy and G.N.P. ... Attractive magnetics with superconducting generators ... Methanol as a renewable resource.

ENGINEERS 53

Technology in developing countries ... A survey of career satisfaction ... Engineers and a culture in transition ... Will this bridge fall down?

I SPY 55

A bug in your ear about the secret watchers.

FUTURE 56

Is world peace possible? ... Technology on the mountain and in the mire.

BIOLOGY 56

Growing the right microbes ... Skunk cabbage: A self-starter ... With hormones, you are what you secrete. ... Two sides to the brain question.

POLICY 58

Has the office of Technology Assessment failed? ... International cooperation on the ocean.

TRANSPORTATION

Blimping Along Together

What a pretty thought, to sail smoothly through the clouds in a gigantic dirigible, moving like a feather, silently, swiftly.

But alas, it is not to be, contend the dollars-and-sense realists who attended the largest gathering of airship authorities since the 1930s in California last September.

Passenger-carrying dirigibles à la luxurious airships of the 1920s were dismissed by the government experts, industrialists, and lighter-than-air enthusiasts (known as "helium heads") at the meeting, directed by M.I.T.'s Flight Transportation Laboratory. The romance surrounding dirigibles does not offset their high costs and lower speeds compared with jet travel.

But between the low-cost, low-speed water and rail cargo transport and the high-cost, high-speed air cargo transport lies a transportation gap which might be filled by technologically advanced cargo-carrying dirigibles. Cost is the key. At ten cents per ton-mile, lighter-than-air transport would begin to fill the cost gap between surface and air transport, and at four cents per ton-mile could capture a significant amount of traffic. These costs might be achieved if 100-knot airships could carry about five times the payload of conventional aircraft. But, this would mean a behemoth craft about 1500 ft. long and 300 ft. around, guaranteed to scare a lot of seagulls, not to mention earth dwellers.

Conference participants admitted that some of their estimates could be off by a factor of four because there were no up-to-date data on which to base cost formulas.

A fascinating array of other lighter-than-air ideas floated about at the meeting, ranging from All American Engineering's "balloon-rotor" to Piasecki Aircraft's "helistat," a combination of four conventional helicopters in a frame attached to a large gas bag. These and

other hybrid vehicles would have the advantage of heavy lifting capabilities, as well as maneuverability. New construction materials and navigation techniques to ensure safety and durability for the airships of the future were also proposed.

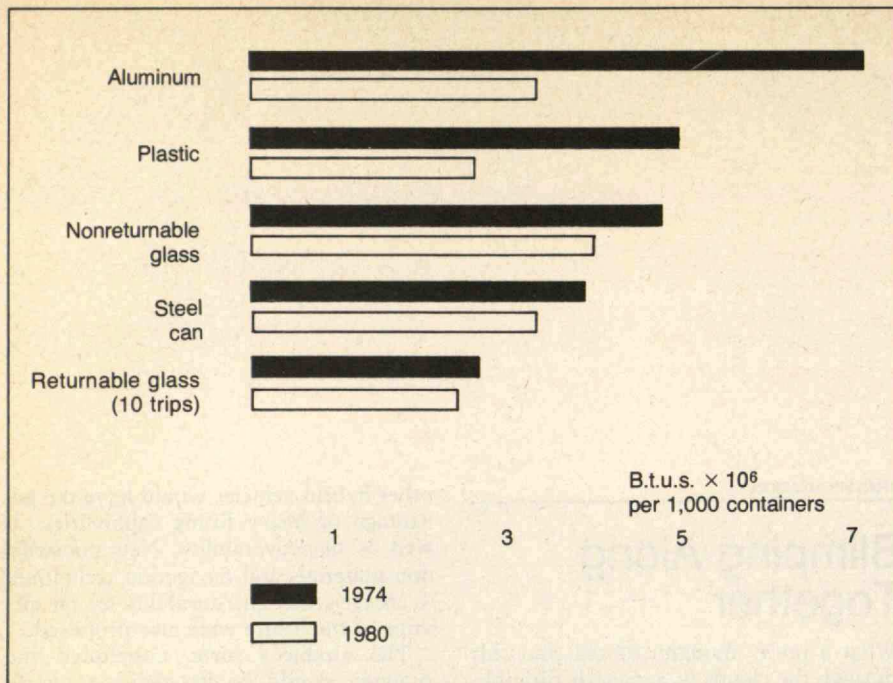
The airship's forte, concluded the analysts, would be its ability to work beyond the capacity of today's aircraft — lifting huge, indivisible loads such as power plant components, or hovering for long periods over areas to be surveyed. Further, airships could offer developing countries cargo-moving capabilities independent of roads, airstrips, or air-traffic control.

The social advantages of airships — low noise and lack of pollution — do make them more attractive, but there still are numerous drawbacks. Huge Astrodome-sized hangars are needed to house the airship for maintenance, and acres of land are required to moor them so that they can swing in a circle with the winds. So much land is needed — a 2000-ft. circle for a 1000-ft. blimp — that only six large blimps could fit in the confines of Boston's Logan Airport, a major air facility.

Availability of helium to fill the cargo dirigibles also represents a large unknown, particularly since helium cannot be manufactured and government programs to store helium found with natural gas are being phased out.

And even though knowledge of weather patterns has increased since the 1920s, airships face different meteorological problems than do other aircraft. Updrafts and other small-scale wind occurrences cannot be overlooked. So violent and unpredictable are present weather patterns over such areas as the Rocky Mountains that some conference members suggested airships should avoid land altogether and stick to overwater routes.

One drawback surprising to most is the "cargo swap" required in airship management: If something is unloaded, something of equal weight must be loaded, or the delicate weight/buoyancy balance of the craft will be thrown out of kilter. Present thinking is that airship crews will have plenty of water to drink when they're not



Food containers will be made with less energy by 1980, thinks Leon Katz, Vice President of American Can Co. The chart shows the energy required per trip for various containers for 12 oz. of beer in 1974 and the amounts that Dr. Katz estimates will be invested in similar containers in 1980.

The difference is partly because half of the materials in the 1980 containers will be recycled, according to Dr. Katz' estimates, and partly because of improvements in technology on which food and container companies are now hard at work.

carrying cargo.

And finally there is the problem of plain old human perversity. Anything as big as a cargo blimp would make an inviting target for anyone with a gun. In fact, rumors persist that the chief repair problem of lighter-than-air vehicles is to patch up all the bullet holes suffered in cruises over inhabited areas. — D.M.

ENERGY

Cutting the Energy in Cans and Bottles

The energy invested per trip in 1,000 12-oz. returnable beer bottles (assuming ten trips from bottling plant to consumer and back again) is 260,000 B.t.u.s. today; by 1980 this form of container — it will still be the most energy-efficient packaging system for 12 oz. of beer — will represent an investment per trip of 244,000 B.t.u.s.

The aluminum beer can — today's most extravagant use of energy at 720,000 B.t.u.s. 1,000 — will be made with only 336,000 B.t.u.s. in five years.

"Dramatic changes in technology" will reduce the cost of almost all food containers by within the next half-decade, says Leon Katz, Vice-President of Research and Development of American Can Com-

pany. At a Michigan State University symposium early this winter, Dr. Katz predicted that half of the materials used in such containers will be recycled by the end of the decade and that new manufacturing technology will permit reductions of 15 to 20 per cent in the amount of materials per container.

Achievement of these goals, however, will depend on allowing technology "to continue without legislative bias to develop lower-energy packaging systems," said Dr. Katz. "Legislative action to force a solution would be counter-productive if this action is based upon insufficient knowledge of research and development achievements."

Since most of the energy required for a food container goes into winning and refining the raw material — up to 85 per cent in the case of an aluminum beer can, Dr. Katz said — some significant energy savings are in prospect.

For a look at the future, consider the recent history of the T.V.-dinner carton: In the decade just ended, the weight of the paper in a carton has been cut by 15 per cent, a saving of 3.6 million lbs. of paper per year; and the wax coating is thinner by more than 50 per cent for an annual saving of 1.75 million lbs. of wax.

There will be other changes, too: new, thinner coatings for metal cans; new processes to reduce the glass content of nonreturnable and returnable bottles (by

20 per cent); new methods of manufacture. Plastic beer bottles — just now coming into use — are fairly energy-intensive: 496,000 B.t.u.s./1,000. By 1980 they'll be less expensive than nonreturnable glass containers — 332,000 B.t.u.s./1,000. All in all, Dr. Katz foresees "significant decreases" in energy required for all container systems. — J.M.

The Nuclear Industry Raises Its Voice

Studies such as the "Rasmussen report" which confirmed the safety of nuclear plants, and the high price of oil have lead the nuclear industry to a new bearishness and a new aggressiveness in challenging its critics (see January, p. 49).

So, it was predictable that the nuclear industry should put more money into financing its mouth, almost doubling the funds devoted to support the Atomic Industrial Forum, an association dedicated to disseminating favorable information on nuclear power.

In the January 17 *New York Times*, reporter David Burnham described a memorandum from A.I.F. President Carl Walske outlining the reasons and uses for the \$1,381,000 budget for 1975-76, up from \$781,000 the year before.

Mr. Walske cited as reasons for the budget hike the pending division of the Atomic Energy Commission, the loss of leadership by the Joint Atomic Energy Committee of Congress, the strength of the anti-nuclear lobbies, and pending legislation involving the nuclear industry.

To fill the gap caused by drying up of A.E.C. public information programs, and to get the nuclear message to state and national legislators, Mr. Walske advocated a direct approach: the holding of press conferences featuring pro-nuclear advocates, arranging media field visits, preparing radio "actualities," placing newspaper features, ghostwriting articles for experts, and placing stories through syndicate services. Past limited budgets had "dictated a program of responding to criticism — a largely negative posture."

"The national media, with the middleman of the reporter and the editor, cannot be relied upon to publish a full and balanced account of nuclear power," said the memorandum according to the *Times*. — D.M.

The Low-Energy Good Life

With the free flow of cheap oil fueling the go-go economy of the 1960s there was no reason to think about a possible connection between energy and G.N.P. But this year a different view is possible: Energy use has gone down, five to ten per cent in

some areas, and the G.N.P. has fallen too. Is our G.N.P. only as healthy as the energy it feeds upon?

Though they admit that they are on slippery correlational ground, Allan Mazur and Eugene Rosa of the Syracuse University Department of Sociology have reported a definite relationship between G.N.P. and energy. "Our national energy activity is in large part identical with our national economy activity, and to that extent a cutback in energy consumption is synonymous with a cutback in economic indicators," they said.

But life style is not tied so closely to energy consumption: The sociologists found no significant differences in life style — health care, education, social satisfaction — between the U.S. and market economies whose per capita energy consumption is lower, such as Denmark, Canada, and Sweden. Based on U.N.-supplied data for 55 countries, they found that "only the divorce and suicide rates are significantly related to energy consumption, and both of these increase with higher energy use."

They are uncertain of the exact nature of the relationship they found in the cross-national study of life style and energy consumption, reported in *Science* magazine for Nov. 15. It is not clear whether G.N.P. has a causal effect upon energy usage or vice versa. Or perhaps energy usage and G.N.P. are merely two rails of a ladder whose rungs are industrialization. But they conclude on a positive note: "So long as America's per capita energy consumption does not go below that of other developed nations, we can sustain a reduction in energy use without long-term deterioration of our indicators of health care, education, culture, and of general satisfaction." — S.J.N.

Electrifyingly Supercool

The saying "the bigger they are, the harder they fall" is nowhere more appropriate than in power generation. Larger generators take advantage of economies of scale, but cause much greater problems when they go out. And larger generators become more likely to "crash" due to their decreased electrical stability in the face of load fluctuations.

But it appears a way has been found to manufacture more and more powerful generators and still keep them physically small and stable — using the phenomenon of superconductivity, in which super-cold temperature causes a conductor to lose its electrical resistance.

At M.I.T. last fall a two-million-watt generator was successfully spun up and mated with the Cambridge, Mass. power system. Preliminary tests indicate the superconducting generator concept is well on its way to practicality.

The generator is unique in that its spinning rotor (3600 r.p.m.) is bathed in a flow of liquid helium at 452°F below zero, eliminating electrical resistance and thus greatly enlarging its current-carrying capacity. The enormous magnetic fields made possible by the high currents outstrip those achievable with standard iron-core generators because of the magnetic limitations of iron.

The armature of the M.I.T. superconducting generator is made of fiberglass and a type of epoxy resin used in rocket casings. The superconducting wire windings of the rotor are an alloy of niobium and titanium, which superconduct at a relatively higher temperature than do other materials. A unique copper "electrothermal" shield surrounding the rotor protects the superconducting windings from fluctuations in the magnetic field, which tend to destroy superconductivity.

Besides being about a fourth the size of its standard counterpart, the superconducting generator will be capable of much higher voltages: Because standard generators need iron cores to enhance the magnetic fields, there is need to insulate the core from the windings — absent in the ironless superconducting generator. Such high voltages obviate the need for costly transformers between generator and high-voltage transmission lines.

The engineers predict that superconducting generators will be used commercially within ten years and will be cheaper than conventional generators because of lower material requirements.

Collaborators on the project, sponsored by the Electric Power Research Institute, include Professors Joseph L. Smith, Jr. and Philip Thullen, and Dr. Thomas Keim of the Department of Mechanical Engineering's Cryogenic Engineering Laboratory; and Professors Charles Kingsley, Jr., James L. Kirtley and Gerald L. Wilson of the Department of Electrical Engineering's Electric Power Systems Engineering Laboratory. — D.M.

Fuel from Wood

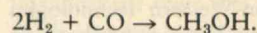
If methanol is the fuel of the future, from where will it come?

Robert M. Lerner and Thomas B. Reed and their colleagues at M.I.T. Lincoln Laboratory are convinced that automobile fuel economy is increased when the fuel contains up to 15 per cent methanol; and carbon monoxide emissions are decreased 20 to 70 per cent (see *March/April, 1974, pp. 61-62*).

U.S. methanol production is today about one per cent of gasoline production. A key question, then, is whether methanol production can be increased so that this "synthetic gasoline" can help reduce U.S. petroleum demand. Drs. Lerner and Reed are optimistic.

Methanol is presently made by combining hydrogen and carbon monoxide ac-

ording to:



Any source that can be burned to produce CO and H₂ will do the job, and this includes all fossil fuels and "the enormous biomass produced continuously by photosynthesis," according to Drs. Lerner and Reed. There is already a plan to use some of the wasted natural gas in the Middle East oil fields to produce methanol for shipment to the industrialized west; ammonia, important as a raw material for nitrogen fertilizer, is a product of the same reaction.

But methanol was first made by the pyrolysis (burning in an oxygen-deficient atmosphere) of wood; small quantities of methanol are a by-product of charcoal manufacture. A far more efficient process, based on liquefaction of wood in the same way coal is liquified, has been tested in the laboratory but is not yet ready for commercial development. Our growing demand for fossil fuel and the fact that at some level of production wood is a renewable resource lead Drs. Lerner and Reed to advocate an aggressive national program of research on wood-based methanol production. — J.M.

ENGINEERS

Western Technology Abroad

Like the magic mirror-on-the-wall, Western philosophers analyzing the impact of Western technologies on developing countries frequently tell us only what we want to hear. According to current wisdom, Western technology is a benign presence bestowed on other countries, and ill effects are due solely to its mishandling.

Some philosophers, however, hold a less flattering — but perhaps more realistic — mirror before Western technology. Among them is Denis A. Goulet, Visiting Fellow at the Overseas Development Council and the Organization of American States, whose studies in Latin America and elsewhere have convinced him that Western technology possesses its own set of values, and that those values may damage the country purchasing that technology.

Dr. Goulet, speaking at M.I.T. in November, outlined what he considers the basic values contained in Western technology:

— A view of rationality as the ability to manipulate objects — to break them into component parts. This fragmenting tendency does injustice to complex, intertwined systems.

— An emphasis on productivity as a measure of efficiency. Westerners are interested only in producing the most for the least. Only recently have Western manufacturers begun to weigh values such as pollution, boredom or dehumanization

by their factories. Conversely, says Dr. Goulet, other non-Western technologies internalize religion, kinship, aesthetic or recreational values into their process of food-gathering, bartering or manufacturing.

— A view that the forces of nature are to be manipulated and put to service. This well-known tenet of technology contrasts with the view in much of the developing world that man is an intimate part of nature and the world environment.

Technology is not bestowed, but sold in an oligopolistic market to countries that need it, concludes Dr. Goulet. It is a product that reflects the politics, economy and sociology of the originating country. For instance, U.S. technology inevitably requires considerable capital, abundant and cheap raw materials and a small, highly-skilled labor force, compared with the scarce capital, few natural resources and abundant but unskilled labor in developing countries. And the expense of goods and services produced by Western technologies limits the markets to only the "haves" of a developing country, leaving the "have-nots" out in the cold.

Such ill-considered technology, says Dr. Goulet, upsets the "dynamism of desire" in developing countries, in which citizens have come to reasonably expect a certain standard of living from usually limited resources. Infected with a "virus of the acquisitive spirit" a developing country's society may be undermined, as aspirations outgrow resources.

Dr. Goulet's answer is for developing nations to forge a sound national policy vis-à-vis imported technology, much along the lines of that developed by the Algerians in a recent workshop he attended:

— Buy only the technology that is needed.
— Insist on tailoring technology to the country. Algerians chided themselves for having bought a machine as it was offered instead of upgrading a simpler purchased version.

— Consider in the cost of a technology the psychological and economic dependency it creates. Even at a higher short-run cost, doing-it-yourself may ultimately be cheaper if it encourages independence. — D.M.

Engineers: Why More Alienated?

"Engineering is an alienating occupation."

But that is not to say, Professor Lotte Bailyn will quickly add, that all engineers are alienated. They are not; many are "very involved with their work."

Professor Bailyn teaches organizational psychology and management in the Sloan School of Management at M.I.T., and her conclusions are based on a survey of M.I.T. bachelor's graduates in the Classes

of 1951, 1955, and 1959. Over 1,300 members of these classes responded to a questionnaire, sent to them in 1970, designed to expose their professional and personal interests and motivations, their feelings about themselves and their careers, and the sources of these attitudes.

Two-thirds of the 1,300 alumni studied in the School of Engineering and two-thirds of those went from M.I.T. into engineering jobs in industry without getting a doctorate or management degree; half of those are still in engineering staff positions, and a quarter of them are now in engineering management. Of this group of alumni, who in 1970 were in engineering-based careers, about one-third are "alienated," says Professor Bailyn. That is, they tend to disagree with such statements as, "I like to think about my work even when I'm off the job" and "My main satisfactions in life come from the work I do"; and they tend to agree with statements such as, "My only interest in my job is to get enough money to do the other things I want to do."

That's more alienation, by far, than shown in any other group of M.I.T. alumni in the survey.

Who are the alienated engineers?

On the average, says Professor Bailyn, they are those with weaker M.I.T. academic records. They are those who see relatively less of their professional colleagues, who lack a "cosmopolitan orientation." Of alumni in engineering staff positions, the alienated engineers are those "more interested in working with people." In general, the alienated engineers work in "the less scientifically-professional, more applied end of the spectrum."

Are increasing management responsibilities the way to increase such an engineer's commitment to his job and reduce his alienation? Not necessarily, says Professor Bailyn. For every alienated engineer there are two other engineers, no more highly trained and having followed very similar career tracks, who are effectively involved in their careers. "It is important to keep this distinction in mind," she writes, "before deciding that any one avenue, be it technical updating, managerial training, or whatever, best fits the mid-career needs of people in engineering-based careers." — J.M.

Engineer: Problem, or Problem-solver?

If the U.S. is entering an era of transition, when we finally understand that finite resources cannot be infinitely depleted by growing population and an ever-higher standard of living, what then shall be the role of the engineer?

Let him look beyond the systems of today — computers that forget, trains that derail, fuels that pollute, radars that see

birds instead of aircraft — to the real problems of this era, says Jay W. Forrester, the controversial author of *Urban Dynamics* and *World Dynamics*. Our problems today, Professor Forrester told the American Society of Mechanical Engineers early this winter, is to come to terms with the transition from a culture oriented to growth to one which understands how to live within its finite means.

As long as a nation has surpluses of space and materials, it can well enough afford to do everything it can devise to improve its life and enrich its coffers. For at least the last 1000 years most of the Western world has found plenty of space to expand in, plenty of fuel to burn, plenty of metal to mine, and plenty of food to eat. Scientists and engineers, in everything they did, revealed new opportunities for us to further benefit from further growth.

But now we are at a crossroads, pressing on a system that is almost fully stressed. Every solution reveals a problem, every advance seems a step backward.

If technology has been the vehicle by which we have achieved this ultimate confrontation, has it the power to help us escape? It has indeed, says Professor Forrester. True, engineering is deeply imbedded in our processes of growth. But growth cannot go on forever, and our opportunity now is to choose between the many pressures by which it can be restrained. Shall we continue our search to eliminate energy as a constraint? Or hunger? Or social stress arising from growing population?

No one is focusing on these questions, says Professor Forrester. But they represent "the fundamental, important interactions of engineering with the dynamics of society." Perhaps the young people of today, who relate engineering more to our problems than to their solutions, are right after all. (One of them, purportedly speaking for the Socialist Worker Party, heckled Professor Forrester — "he has complicity for the genocide in South Asia!" and "there is no resource shortage!" — as he began the Towne Lecture, but was hustled off before this image of himself was revealed.) — J.M.

The Inexact Art of Engineering Prediction

Prediction is the very heart of the practice of civil engineering; the successful engineer must make decisions and take actions based on his predictions of loads and strengths, actions and reactions. But how do engineers decide what criteria to use in predictions? More important, how do engineers evaluate their prediction techniques?

Hard questions, because opportunities for civil engineers to study true construc-

tion failures — where predictions were inadequate — are rare. As a result, it's difficult to find feedback data to use in evaluating current prediction methods.

Early last year T. William Lambe, Edmund K. Turer Professor of Civil Engineering at M.I.T., found an ideal situation for an experiment in prediction. Construction of an extension of Interstate-95 highway 15 miles north of Boston was halted; the work was abandoned with no plans to continue. The route included a 2.4-mile embankment placed on marshy peat, and Professor Lambe obtained permission to use a 300-ft. section of this embankment for a practical evaluation of prediction techniques.

Professor Lambe proposed to load the embankment with fill at the rate of about one to two ft./day. Field test measurements of pore pressure, horizontal movement, and settlement would be taken at the outset of the experiment and again after six ft. of fill had been loaded. Then loading would continue until the embankment failed, when measurements would be again taken. The total height of the embankment at failure was to be recorded.

Meanwhile, Professor Lambe found ten civil engineers, representing both research and practicing design interests, who agreed to study data on the embankment and make predictions before the loading began. They were asked to predict the pore pressures and vertical and horizontal displacements at six ft. of load as well as the height of the embankment when its foundation failed.

Then the experiment began; but the loading and other measurements made at failure were kept secret, pending a symposium at which the predictions and results would be revealed and the issues they raised would be discussed.

When the symposium opened at M.I.T. late last fall, a wide range among predictions was immediately evident. The first two predictions heard were 27 ft. and 13 ft. of loading at failure — a taste of things to come. When all the predictions were heard, the range of loading at failure was from 8 to 27 ft., a total embankment height at failure of between 46 and 65 ft.

Then came the moment of truth: The embankment had "failed beautifully" when 18.7 ft. of fill had been placed on it — a total height of 56.7 ft. at failure, said W. Allen Marr, Jr., a graduate student working with Professor Lambe. The closest result was that of the Cambridge University team of J. M. Hughes and C. P. Wroth — a prediction of 59 ft.

The spread of predictions was about 20 per cent of the total height either way, from 46 to 65 ft. No one was surprised at this range of estimates. Naturally-occurring soils are highly variable, and soil engineers are used to using insufficient and inaccurate information to predict the behavior of unseen soils underneath structures. For such reasons, high safety fac-

tors are common in civil engineering projects, for how can one afford to economize under conditions of such uncertainty? — *Barbara L. Moore*

ISPY

He Knows When You Are Sleeping, He Knows When You're Awake

Considerable anguish has been spent of late over growing intrusions upon our privacy by government, business, and even neighbors. New technology, say viewers-with-alarm, means that computers, two-way cable television, and other electronics will make privacies public.

But most people do not realize that technicians running public utilities already have a pretty good idea of what the public is doing, at least collectively.

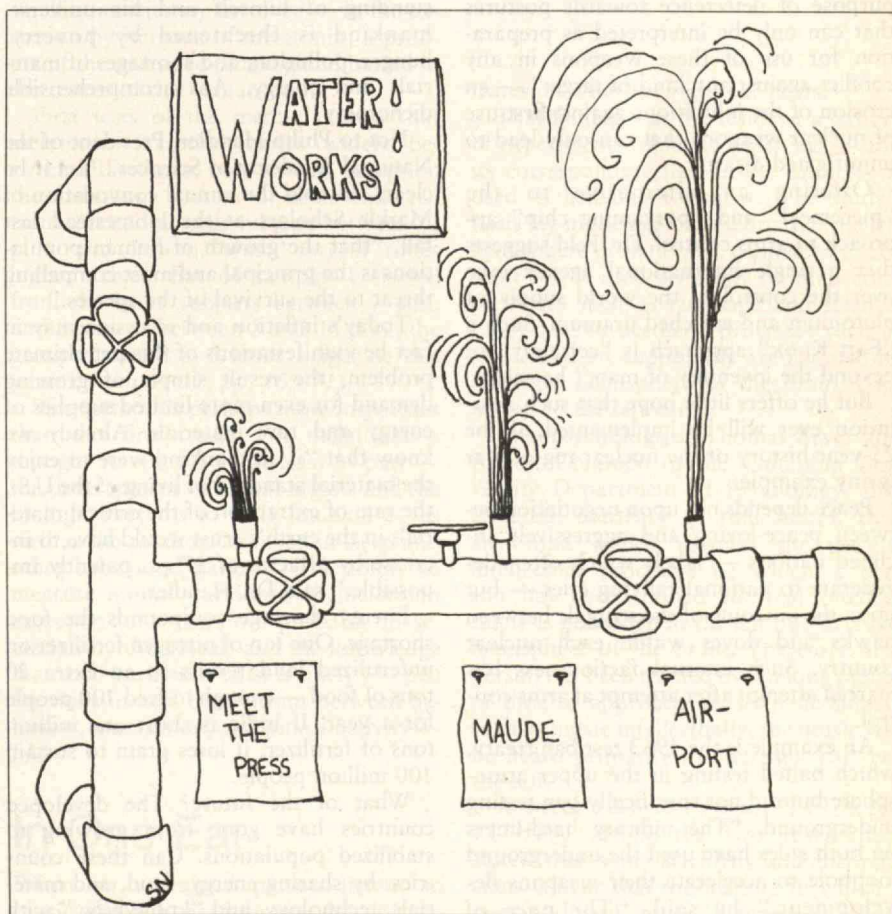
A few examples:

Electric power grid operators testify that one of the most popular shows ever on television was the marriage of Tiny Tim, of tulip-tiptoeing fame, on the Johnny Carson Show a few years back. They know because at the very moment

the show ended, the mass of viewers switched off their sets almost simultaneously, causing a power surge of about 200 million watts.

Similarly, gauge watchers in the Waterworks Department in Lafayette, La., have developed their own unique method of measuring the popularity of various television shows: They measure the drop in water pressure at the end of a telecast when viewers troop to bathrooms and subsequently flush their toilets. The record drop in pressure so far, according to an article in the February issue of *Playboy*, was 26 pounds for "Airport," which the waterworkers interpret as 20,000 people using 80,000 gallons of water. Other contenders have been "Patton" at 22 pounds, and "The Good, the Bad and the Ugly" at 19 pounds.

The psychological impact of calamities, minor and major, can also be measured by the utility-watcher's method. This writer remembers the results of a small flood which struck a small Texas town where he worked one summer in the local telephone office. As the waters rose, so did the clatter of switches in the office as telephone calls went through. Finally, the waters peaked, and the telephone lines were swamped — not by water, but by warblers trapped in their houses telling tales of misfortune over the phone. — *D.M.*



Water works technicians have been able to gauge the popularity of television programs

by the drop in water pressure in the city pipes at the program's end.

Hawks and Doves

Professor Bernard Feld, one of the pioneers who worked on the first atomic bomb in 1945, remains an optimist. Since his early experiences, and his subsequent participation in the founding of the Pugwash group of international scientists concerned about nuclear warfare, he has maintained that world peace is possible.

So when Bernard Feld gives the world a 50-50 chance that nuclear weapons will be used before the end of the century, consider it seriously. "Having devoted half a lifetime to the pursuit of what now appears to have been a will-of-the-wisp, I am forced to the conclusion that the arms control approach simply does not work in today's world," he says. "A different approach is essential if nuclear disaster is to be averted."

Dr. Feld, Professor of Physics at M.I.T., is now on sabbatical serving as Secretary General to the Pugwash group. Addressing the J. D. Pernal Peace Library in London last fall, he explained that he considers SALT I a "step backwards."

"The main result of SALT has been to initiate a new phase of the nuclear arms competition, in which both sides are moving steadily from their earlier posture of reliance on nuclear weapons for the sole purpose of deterrence towards postures that can only be interpreted as preparation for use of these weapons in any conflict against any kind of target" — an erosion of the inhibitions against first-use of nuclear weapons that can only lead to unmitigated disaster.

Offering an alternative to the "piecemeal" and "bargaining chip" approach to arms control, Dr. Feld suggests that a single international agency take over the control of the world supply of plutonium and enriched uranium. Such a "Fort Knox" approach is "certainly not beyond the ingenuity of man," he said.

But he offers little hope that such a solution ever will be implemented, if the 25-year history of the nuclear tug-of-war is any example.

Peace depends not upon negotiation between peace-loving and aggressively inclined nations — labels which often degenerate to national rallying cries — but upon the outcome of the struggle between hawks and doves within each nuclear country. Such internal factiousness has marred attempt after attempt at arms control.

An example is the 1963 test ban treaty, which halted testing in the upper atmosphere but did not specifically ban testing underground. "The military hard-liners on both sides have used the underground loophole to accelerate their weapons development," he said. "The pace of weapons development, instead of being inhibited by the treaty was, if anything, increased."

SALT I brought about the same sort of military waltz — one step forward internationally, two steps back at home. The results of the SALT agreement have been "taken as a signal by the military weaponeers on both sides to go full-steam ahead on every new weapons scheme that is not explicitly prohibited by the agreement."

"It would be difficult to find a better example of the operation of the military death wish," said Dr. Feld.

Dr. Feld attributes these defeats on the home front to the "conflicting ideologies" and "false dichotomy between national loyalty and loyalty to mankind" on the part of the doves. The military hawks, on the other hand, "have learned how to work in concert, how to reinforce each other and to divide the opposition so as to convert every international arrangement into an internal victory for their hard-line approach."

The survival of mankind demands a new approach, said Dr. Feld. "Doves of the world unite — you have nothing to lose but your planet." — S.J.N.

Technology in the Darkening Future

Despite unparalleled scientific understanding of himself and his universe, mankind is threatened by poverty, hunger, pollution, and shortages of materials and energy. An incomprehensible dichotomy?

Not to Philip Handler, President of the National Academy of Sciences. "Let it be clear," he told the annual convocation of Markle Scholars at the Homestead last fall, "that the growth of human populations is the principal and most compelling threat to the survival of the species."

Today's inflation and recession may in fact be manifestations of this penultimate problem, the result simply of growing demand for even more limited supplies of energy and raw materials. Already we know that "if all mankind were to enjoy the material standard of living of the U.S., the rate of extraction of the critical materials in the earth's crust would have to increase by a factor of 17 . . . patently impossible," said Dr. Handler.

Energy shortage compounds the food shortage. One ton of nitrogen fertilizer on unfertilized land results in an extra 20 tons of food — enough to feed 100 people for a year. If India is short one million tons of fertilizer, it loses grain to sustain 100 million people.

What of the future? The developed countries have gone from growing to stabilized populations. Can these countries, by sharing energy, food, and materials, technology, and "know-how," with unprecedented generosity, now bring the rest of the world to this stage of transition — and do so in time to stabilize world

population at a level consistent with global resources?

Dr. Handler is not sure.

Ironically, he thinks, that just as the developed nations weigh this opportunity they are confronted by "a massive outflow of capital" to the petroleum cartel; the result may be that "world decision-making capability" will now be placed in O.P.E.C. hands.

"I have difficulty facing the future with equanimity, difficulty in imagining a happy outcome," he admitted to the Markle scholars. Though he remains optimistic about the power of technology to further improve man's use of materials, he nevertheless proposes that "a drastic change is inevitable in the life of those privileged to live in the most developed nations." And without political wisdom and strength to bring the fruits of technology to all peoples quickly, then the future seems dark indeed. — J.M.

BIOLOGY

Enzyme Assembly Line

When the drug industry sets out to produce a single antibiotic, it frequently ends up forced to grow a whole herd of microbes — like an automobile mechanic forced to buy a factory when all he wants is a screwdriver.

The economics of antibiotic production are, in fact, downright absurd. The horde of antibiotic-producing microbes use only about ten per cent of their feed to produce the desired antibiotic; the rest is expended on the process of living and reproducing. And after the microbes are grown, the wanted antibiotic must be separated from masses of biological garbage.

Can a way be found to concentrate the effort on antibiotic-producing enzymes? Perhaps. Earlier this year, Professor Daniel I. C. Wang and an interdisciplinary group of M.I.T. chemists, food scientists, biochemical engineers, microbiologists and chemical engineers achieved the first total large-scale synthesis of an antibiotic using only enzymes. The antibiotic, gramicidin S, has no economic significance; it was chosen simply as a well-known entity amenable to scientific probings. But another enzyme widely used to fatten cattle — bacitracin — is next on the scientists' list, and it will probably be the first commercial antibiotic produced by enzymes. Such syntheses will be the fruit of an intensive, organized attack on the problem whose stages include puzzling out the gramicidin synthetic machinery; producing bacteria from which to extract the enzymatic machinery; figuring out how to handle and retrieve the delicate enzymes so they can repeat their jobs over and over; and finally, scaling up the laboratory process into pilot-plant size.

Single enzymes are widely used to produce a number of useful products from tanned leather to cheese. What's unique about the M.I.T. project is the scientists' isolation and use of complexes of several enzymes — a whole biological assembly line, as it were. — D.M.

Blooming Thermostat

The first spring wild flower in New England is the skunk cabbage, whose shoots and blooms penetrate late-winter snowbanks and ice-covered marshes almost before the rest of us can find evidence that winter is ending. Now comes a surprising seasonal report: Skunk cabbage flowers are not frost-resistant, and the plant protects itself against freezing by generating its own heat — the amount of which varies according to the temperature.

These observations are the work of Professor Roger M. Knutson of the Department of Biology at Luther College, Decorah, Iowa, reported in *Science* even as winter was arriving (November 22, 1974, pp. 746-47).

The mechanism for heat generation is simple enough: Large quantities of starch are stored in the massive root of the skunk cabbage; the starch is digested into sugar and in this form energy is brought to the flower by the plant's circulatory system, where it is reacted with oxygen to yield the protective heat energy. The signal from the top of the plant that causes and regulates this starch digestion remains "one of the fascinating problems," writes



Though it is the earliest of spring flowers, the skunk cabbage is not frost-resistant; it escapes freezing by maintaining a high respiratory rate, consuming food stored in the plant's large root at rates which depend on the temperature against which the plant requires protection. Such a system, which involves maintaining elevated respiration rates for days or weeks, may be unique in all the plant kingdom, thinks Professor Roger M. Knutson of Luther College.

Dr. Knutson. The oxygen consumption of a typical flower at 0° C. is 12.8 ml./g./hr., and if a typical flower weighs 4.5 g., this is "roughly comparable to the rate for equivalent-sized small mammals," writes Dr. Knutson. For each 10° C. drop in air temperature, oxygen consumption doubles.

But when you venture forth in the March blizzard to observe this remarkable harbinger of spring, resist the temptation to pick the flower; it has no starch storage whatsoever and begins to cool immediately, writes Dr. Knutson. — J.M.

Behind the Rhythms of Growth and Life

How does the human body regulate its growth and development, its cycles of activity and repose?

No one knows. But every evidence suggests that a complex balance of very subtle chemistry is at work to make us what we are and do what we do.

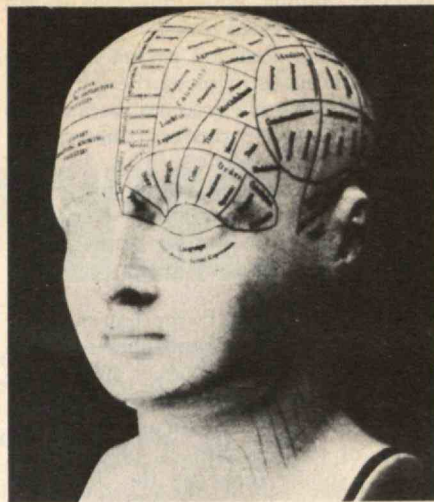
A new shred of evidence has now been added by Harry J. Lynch, Dr. Richard J. Wurtman, Michael A. Moskowitz, Michael C. Archer, and M. H. Ho of the M.I.T. Department of Nutrition and Food Science. They have found and tested a way to measure variations — extremely small quantities are involved — in the excretion by humans of melatonin, a product of the pea-sized pineal gland buried in the center of the human brain.

First tests of the method reveal that melatonin excretion varies widely between individuals; but without exception the melatonin content of urine collected from three adult male subjects between 11 p.m. and 7 a.m. was "several times higher" than that of samples collected from the same subjects between 7 a.m. and 3 p.m. or between 3 and 11 p.m., the group reported in *Science* magazine this winter (January 17, pp. 169-71).

The method is perhaps more important than this first result. For melatonin is thought to control — at least in part — the development of sexual organs and the biologic rhythms in their function — as well as the rhythms involved in sleep and other behavioral patterns. The ability to measure minute variations in melatonin excretion (and therefore probably in secretion by the pineal) and the knowledge that such variations exist is likely to open the door to new correlations between behavior, maturation, and pineal activity — J.M.

In One Ear

When an untrained person listens to music through headphones, he concentrates on the sound going into the left ear. When a trained musician listens to music under similar circumstances, he concen-



The ancient pseudo-science of phrenology assumes that certain areas of the brain govern specific functions. To an extent the ancients have been proven correct — the right hemisphere of the brain generally governs artistic and emotional impulses, and the left takes care of rational and intellectual thought. One new study links music appreciation and the brain's left hemisphere, perhaps indicating a new definition of art. (Photo originally published by the University of California Press; reprinted by permission of The Regents of the University of California.)

trates on what the right ear hears.

That finding was the result of a battery of experiments to detect which ear — and its corresponding half of the brain — is used in listening to music. The study's basis lay in the age-old theory that the left hemisphere of the brain, connected to the right ear, is used primarily in intellectual processes such as language and science. Emotional or aesthetic processes such as music and art supposedly are handled by the right hemisphere of the brain, connected to the left ear.

Two psychologists, Thomas Bever and Robert Chiarello of the Columbia University Department of Psychology, discovered, contrary to that belief, that any topic which requires the use of intellectual processes or which a person has been trained to treat intellectually is processed in the left (intellectual) hemisphere of the brain. Therefore, if a person has been trained over a long period of time to approach an aesthetic subject such as music intellectually, the music will be heard primarily by the right ear, not the left.

In a recent *Science* (August 9, 1974, pp. 137-139) article the two researchers stated that some scientists and theoreticians concur that the manner in which a person digests music determines which half of the brain he uses. Naive music listeners hear music as a complete string of melodies and focus on "the overall

melodic contour" while musicians discern a "series of isolated tones."

In fact, the longer a person listens to music, the more involved the left hemisphere of the brain becomes, because the trained listener perceives counterpoint, harmony, and cadences. This, in turn, reveals the possibility that there are "neurological concomitants" — that the nerves involved in hearing music play a subordinate role in the perception processes.

Age is a less strong factor than exposure in determining brain hemispheres, the researchers found. In younger subjects — choirboys and their untrained peers — ears made no difference in accurate recognition of tonal sequences. Nevertheless, faster response times for the choir-boys occurred in the right ear (intellectual brain half) than in the left ear (emotional half), and the longer the subject had been in the choir, the faster he responded to the sequences.

Does right- or left-handedness make any difference in which half of the brain was used? The right hand is connected to the left (intellectual) hemisphere and the left hand to the right (emotional) hemisphere; theoretically, if a person is right-handed, the left half of his brain is more developed than the right half of his brain.

True to that theory, musically experienced right-handers who had no left-handed relatives were best at recognizing musical intervals, whereas non-musical right-handers who had left-handed relatives did worse than non-musical right-handers with no left-handed relatives.

So, if you've been told many times that you are incorrigibly tone deaf, maybe you ought to try the other ear. — C.C.S.

POLICY

Technology Assessment: Must It Be a Cacophony?

Asked to describe a process of technology assessment, most of us will resort to the measured phrases of Emilio Q. Daddario, Director of the Office of Technology Assessment which serves the U.S. Congress. The purpose, says the enabling legislation, is to provide "early indications of the probable beneficial and adverse impacts" of new science and engineering.

O.T.A.'s creation, said Mr. Daddario this winter upon receiving the Ralph Coats Roe Medal of the American Society of Mechanical Engineers, was "an act of faith on the part of the Congress that an improved ability to anticipate and understand the consequences of technology will aid in the solution of national problems."

All this implies to Dr. P. D. McTaggart-Cowan, Executive Director of the Science Council of Canada, an orderly, analytical process conducted by

specialists whose pronouncements will be "delivered in a black box to legislators who then make political decisions."

But that model is simply not the way the world works, Dr. McTaggart-Cowan told students in M.I.T.'s "failure" seminar this winter; and so he thinks O.T.A. is in "imminent danger of failing."

The problem is this: Assessment is in fact an ongoing decision-making process that never stops, the success of which depends on constant illumination of all possible points of view. A singular effort such as O.T.A.'s will almost surely fail to bring all the needed "actors on stage" — simply because at any crucial moment no one knows who all the actors are.

Dr. McTaggart-Cowan referred to a Science Council study by Michael Gibbons of the University of Manchester and Roger Voyer of the Science Council staff: A technology assessment "system ... comprises those social groups which are (or should be) concerned with effecting a given technological program."

For example, consider the Science Council's study of assessment as it has occurred during Canada's debate on offshore oil exploitation. In the beginning, offshore oil was discussed by only two parties — oil companies acting in concert with the Canadian Department of Energy, Mines, and Resources. Gradually others became involved: the governments of the Eastern provinces, because of the potential economic impact; then fishermen; then ecologists and wildlife specialists. "In order to have a true technology assessment," write Drs. Gibbon and Voyer, "it is essential that those groups which should be involved, but which for some reason, varying from lack of awareness to lack of effective organization, have not been, become part of the technology assessment system."

The approach of O.T.A. is in sharp contrast; that agency has signed a \$521,000 contract with a consulting engineering firm for an assessment of the likely effects of oil drilling, nuclear plants, and tanker anchorages on continental shelf areas off the coasts of New Jersey and Delaware.

But should we really return to such cacophonous debate as that over the S.S.T. (which still continues), eschewing the orderly, systematic process implied by O.T.A.'s present activities? Dr. McTaggart-Cowan's answer is yes, that otherwise we are in danger of deluding ourselves into thinking we have an assessment when in fact we have but one dimension of it. — J.M.

A Champion for the World Ocean

As land-based resources are depleted, we turn to the seas; hence growing interest on the part of all nations for jurisdiction over and judicious utilization of their adjacent waters. Now 200 miles is the frequently

mentioned limit, and oceanographers and social scientists alike find the implications "overwhelming." Less developed nations are growing wary, and marine scientists are increasingly discouraged in their efforts to conduct research off the coasts of Latin America, Africa, and Asia.

These new constraints reflect the fact that the developing countries want the opportunity to develop their marine resources. But in many instances they will need help to find and exploit resources and to deal with related national and regional marine problems such as pollution and coastal zone management.

Concerned that this stalemate will jeopardize scientific research important to all, the National Sea Grant Program asked the M.I.T. Department of Ocean Engineering for recommendations: How can more effective international cooperation in the exchange of marine information and expertise come about?

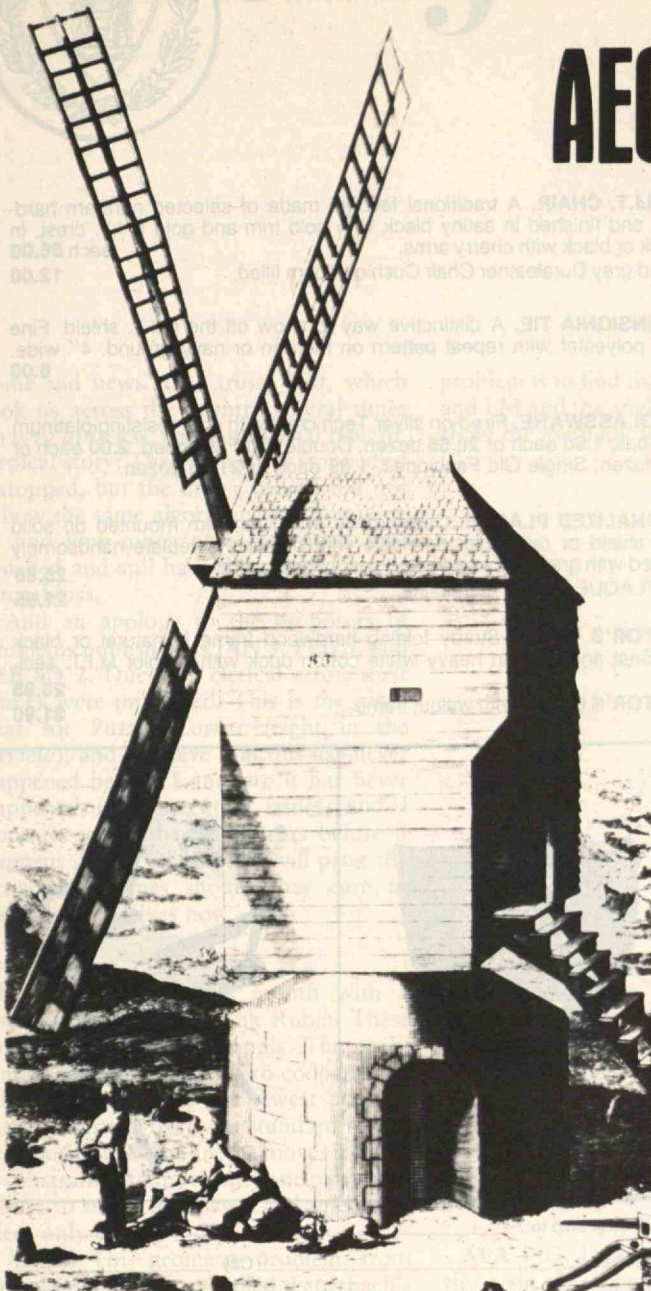
The answer: an "international sea grant program" based on the principles which have made the National Sea Grant Program a valuable program in the U.S., says Judith T. Kildow, Assistant Professor of Ocean Policy at M.I.T.

Such a program's key tasks, Dr. Kildow said in the annual M.I.T. Sea Grant Symposium last fall, would be those of "catalyst, broker and memory bank, matching needs with expertise and information." It would help identify appropriate Sea Grant or Sea-Grant-related marine expertise in this country, encourage the development of joint project proposals, and disseminate information useful to participants and others dealing with similar problems. For example, Dr. Kildow said later in a paper for the seventh annual meeting of the Sea Grant Association in Seattle, there is an underutilized laboratory in Sonora, Mexico, and a number of potential problems in coastal zone management on its doorstep. Talent is needed, for which modest funds could be made available.

But problems and funding do not assure success. "Many efforts at international cooperation in marine-related areas are short-lived and fall short of expectations," Dr. Kildow reminded the Sea Grant Association. A new agency will be needed — at present no existing international group is adequately positioned to do it; and it should approach its task "with deliberation," moving ahead gradually from a program which may cost \$5 to \$7 million in the first year.

The most important goals of such an agency would be "to make sure that people everywhere become fully aware of the implication of long-term global problems such as marine pollution and resource utilization and management" and to encourage equal commitment and participation on the part of involved nations. If it succeeds in this alone, Dr. Kildow said, the international Sea Grant program would be "a good investment for the future." — J.M.

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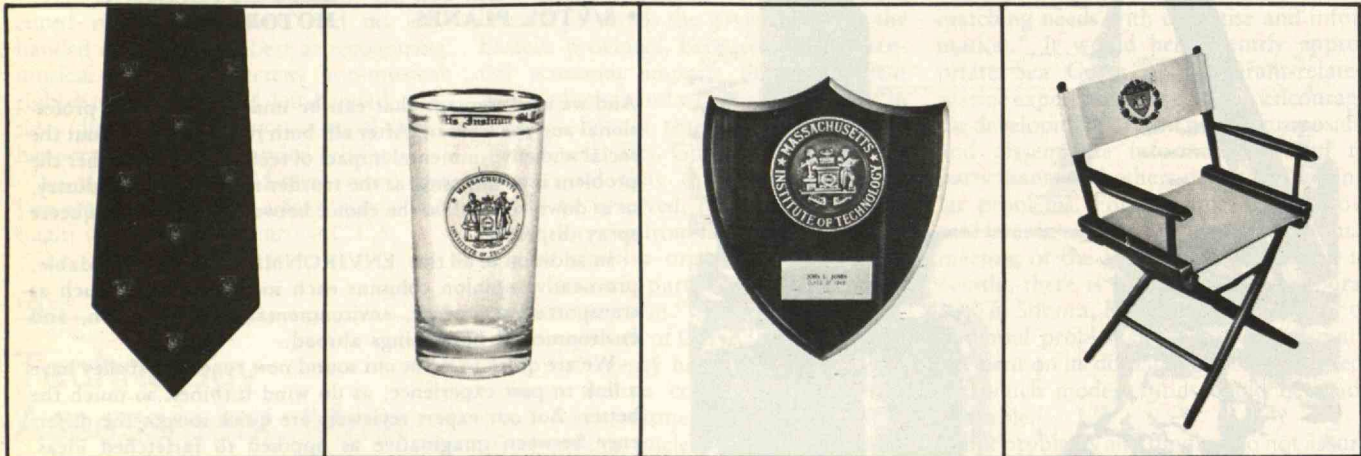
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Euclid Asks a Tough Question

Puzzle Corner
by
Allan J. Gottlieb

Some sad news. Our trusty Fiat, which took us across the country several times on *very little* gas, has met its final reward. Typical story: The car in front stopped so I stopped, but the driver behind did not follow the same algorithm. It is annoying to find how much of a car can be untouched and still have the car considered a total loss.

And an apology to the proposers of problems published as JAN 3, FEB 3, and FEB SD 2. Due to a clerical error, their names were misplaced. This is the ninth year for Puzzle Corner (eight in the *Review*), and I believe that this has never happened before. I am *sure* it has never happened in consecutive issues, and I hope to go another nine years before it happens again. Of course I will print the proposers' names should they care to identify themselves now.

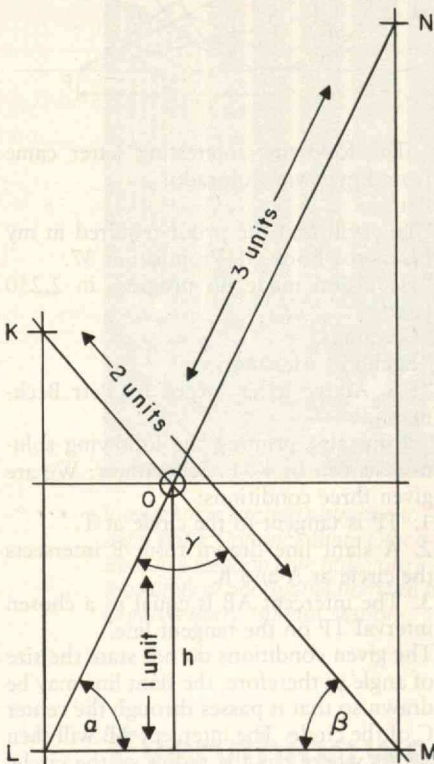
Problems

M/A 1 We begin this month with a chess problem from Frank Rubin. These problems are in short supply. The problem: Black and White are to cooperate to checkmate White in the fewest possible moves, starting from the standard beginning position. What are the moves if Black is constrained to move only one pawn and White to move one pawn and one other piece only once?

M/A 2 This geometry problem, from Eric Jamin, is often called Feuerbach's Theorem. It begins with the nine-point theorem which was published as O/N 3 in 1973: Consider a triangle; prove that the three midpoints of the sides, the three basepoints of the altitudes, and the three midpoints of the segments joining the vertices to the orthocenter (the common intersection of the three altitudes) all lie on one circle. Now Mr. Jamin wants you to show that the "nine-point circle" defined above is tangent to the inscribed circle and to the exscribed circles.

M/A 3 The following is from Walter G. Walker, who wants you to determine the sides and angles of the triangle LMO (uniquely defined) in the drawing. The two parallel lines KL and MN are perpendicular to the base LM. The height (h) is 1 unit, KM is 2 units, and LN is 3 units. The

problem is to find the lengths of LO, OM, and LM and the angles α , β , and γ , and to show the methods and proofs used.



M/A 4 D. J. Huntley wants you to devise a simple scheme for deciding if a binary number (i. e., a number expressed in base 2) is divisible by 3.

M/A 5 R. E. Crandall suggests that we look for three distinct positive integers such that the sum of any two is a square.

Speed Department

SD 1 Our first "speed" problem is a "Back-all Original," courtesy of F. Steele Backall: An inveterate jogger whose regular pace was consistently one mile in eight minutes noted that in the heavy traffic hours the flow of traffic was very steady, as to both the interval between cars and their speed. He also noted that there were more cars travelling in a northerly direction than in a southerly direction. One morning curiosity brought him to count the cars passing him as he jogged along his

stretch of road. As he headed south from his home, he was interested to see that four times as many cars passed him headed north as headed south. When he turned around and headed north back to his home, he was startled to find that an equal number of cars passed him going in both directions. What was the speed of the traffic in miles per hour?

SD 2 Gary A. Ford says that an integer m contains an integer n if the digits of n form a subset of the digits of m. For example, 123 contains 1, 2, 3, 12, 13, 21, 23, 31, 32, 123, 132, 213, 231, 312, and 321. He asks, What is the smallest four-digit integer containing exactly five consecutive powers of some integer $Q > 1$?

Solutions

The following are solutions to problems published in the December, 1974, issue.

DEC 1 With the following hands, South has a seven-hearts-doubled contract and West leads the $\spadesuit 9$. Can South make his contract?

\spadesuit A Q 10 7	\spadesuit K J 6 3
\heartsuit 9 7 6 5 4 3	\heartsuit 10
\diamondsuit 2	\diamondsuit 9 7 6 5
\clubsuit Q 7	\clubsuit 5 4 3 2
\spadesuit 9 8 5 4	\spadesuit 2
\heartsuit J	\heartsuit A K Q 8 2
\diamondsuit K Q 4 3	\heartsuit A J 10 8
\clubsuit K J 9 8	\clubsuit A 10 6

The following is from Edward Gershuny: South can make the contract. He plays the first ten tricks as follows:

1. Win with the $\spadesuit A$.
2. Lead $\spadesuit 10$. East must cover with the $\spadesuit J$ and South trumps with an honor.
3. Lead a high trump to pull the defenders' teeth.
4. Lead the $\heartsuit 2$ to the board's $\heartsuit 4$.
5. Lead the $\clubsuit Q$. East must cover with the $\spadesuit K$ and again South trumps high.
6. Cash the $\clubsuit A$.
7. Lead the $\heartsuit 8$ to the board's $\heartsuit 9$.
- 8, 9, and 10. Play three rounds of trump. South discards two clubs and a diamond.

In case 3 C has a prime factor p such that $p \equiv 3 \pmod{4}$. Either A and B are both multiples of p , or neither is. Suppose A and B are *not* multiples of p . The numbers $1, 2, 3, \dots, p-1$ are an abelian group under the operation of multiplication mod p . Call this group G . Let a, b be the elements in G for which $A \equiv a \pmod{p}$ and $B \equiv b \pmod{p}$. Then

$$a^2 + b^2 \equiv 0 \pmod{p}$$

$$a^2 \equiv -b^2 \pmod{p}.$$

Let a^{-1} denote the inverse of a in G . Then $(aa^{-1})^{-1} = 1$.

$$a^2(a^{-1})^2 \equiv -b^2(a^{-1})^2 \pmod{p}$$

$$1 \equiv -(ba^{-1})^2 \pmod{p}$$

$$(ba^{-1})^2 \equiv -1 \pmod{p}.$$

The elements $ba^{-1}, p-1, (ba^{-1})(p-1)$, and 1 form a subgroup of G which has four elements. Therefore, the number of elements in G must be a multiple of four (Lagrange's Theorem in Group Theory). But G has $(p-1)$ elements and $p-1 \equiv 2 \pmod{4}$.

This contradiction renders the hypothesis invalid. A and B are multiples of p , and $(A/p)^2 + (B/p)^2 = (C/p)^2$. Every C must fit at least one of cases 1, 2, and 3, so the proof is complete.

Responses were also received from Gerald Blum, Avi Ornstein, R. Robinson Rowe, and Victor Sauer.

DEC 5 What strategy minimizes the amount of gas consumed (= miles travelled) traversing a 1,000-mile flat desert by car? The car gets 10 m.p.g.; its tank holds 25 gal. of fuel, and fuel may be carried in no other way; fuel may be left at any point along the way; there is an unlimited supply of fuel at mile 0; but, except for what is cached, gas is not available anywhere along the way.

Most answers agree to 3 or 4 decimal places. The following is from Harry Zarembo:

In the diagram shown on the next page,
 S_0 = destination point
 S_{n+1} = departure point
 S_i = any fuel station established en route ($i = 1, 2, \dots, n$)
 d_i = distance between any two stations
 D_n = distance from departure point to the last established fuel station
 D = total distance to destination
 C = car's tank capacity in equivalent miles

Each expression in the box at each station is equal to the fuel which remains at that station before the final trip from S_{n+1} to S_0 . The derivation of each expression is predicated on the following strategies to effect the most efficient and minimum consumption of gasoline:

1. Fuel tank of car is always maintained full before leaving any station S_{i+1} for S_i ($i = 0, 1, \dots, n$).
2. Fuel tank is permitted to contain only the amount of fuel necessary to reach station S_{i+1} when departing S_i ($i = 1, 2, \dots, n$).

We put it all together.

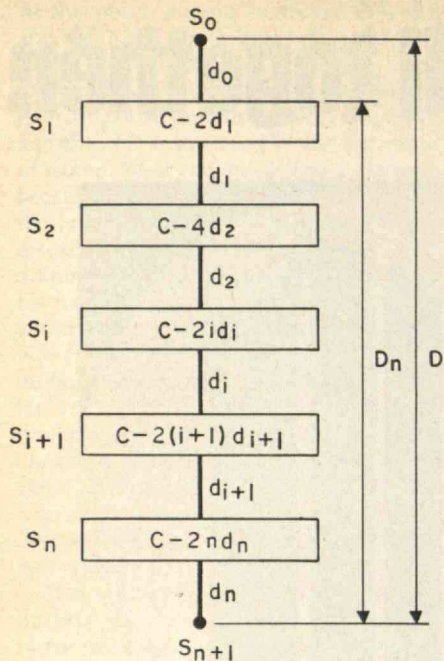


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In general, as a result of (1) the fuel consumed over distance d_i to reach S_i must be replenished at S_i to maintain a full tank; thus, on the final trip to S_0 ,

$$C - d_i + (C - 2id_i) = C,$$

or

$$d_i = C/(2i + 1),$$

and

$$D = d_0 + D_n = d_0 + \sum_{i=1}^n d_i = d_0 + C \sum_{i=1}^n 1/(2i + 1).$$

The fuel represented by D_n in miles will be completely consumed and that corresponding to $d_0 = C$ will also be depleted if the tank is empty on arrival at S_0 . With an arbitrarily selected $D = 1,000$ miles, and $C = 250$ miles, then $d_0 \leq 250$ and

$$D_n = 250 \sum_{i=1}^n 1/(2i + 1) \geq 750.$$

Hence

$$\sum_{i=1}^n 1/(2i + 1) \geq 3,$$

which is satisfied when $n = 418$, resulting in

$$\sum_{i=1}^{418} 1/(2i + 1) = 3.000690592.$$

Consequently, $D_n = 250 \times 3.000690592 = 750.172648$ miles, and $d_0 = D - D_n = 249.827 - 352$ miles; and the car arrives at S_0 with $0.1(C - d_0) = 0.0172648$ gal. to spare. The total fuel consumed is equal to the number of times the tank was filled at the departure point less the amount remaining in the tank on arrival at S_0 . If G is the total fuel consumed,

$$G = 0.1(n + 1)C - (C - d_0)$$

$$G = 0.1(nC + d_0) = 10474.982735 \text{ gal.}$$

Also solved by Edward Gershuny, Har-

vey Goldman, Neil Hopkins, Richard Kimble, Jr., R. Robinson Rowe, and Allen Wiegner.

Better Late Than Never

Responses to the problems indicated have been received:

O/N1 Gerald Blum and Paul Reeves

O/N2 Gerald Blum, Avi Ornstein, and Paul Reeves

O/N3 Gerald Blum and Charles Foster

O/N4 Gerald Blum, William Blum, Leonard Charek, Robert A. Keller, Michael Kotch, Paul Reeves, and John Welch.

Proposers' Solutions to Speed Problems

SD1 22.5 m.p.h.

SD2 1256 contains 1, 5, 25, 125, and 625.

Allan J. Gottlieb studied mathematics at M.I.T. (S.B. 1967) and Brandeis (A.M. 1968, Ph.D. 1973), and he is now Assistant Professor of Mathematics at York College of the City University of New York. Send problems, solutions, and comments to him at the Department of Mathematics, York College, 150-14 Jamaica Ave., Jamaica, N.Y., 11432.

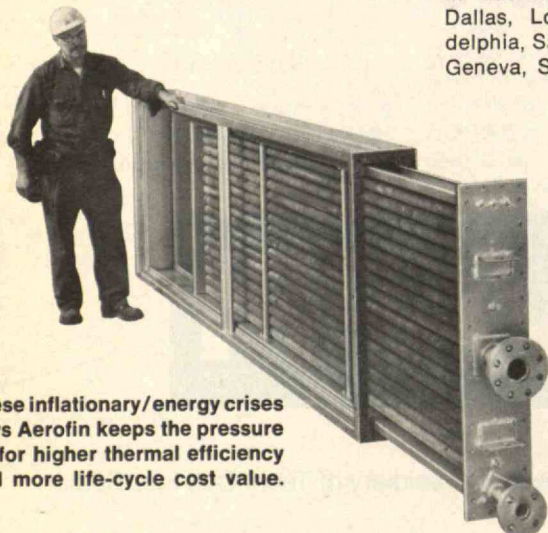
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Type B - (3/8" tubes) Bulletin B-58

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The Importance of Nuclear Self-Criticism

The Nuclear Fuel Cycle

D. F. Ford, T. C. Hollocher, H. W. Kendall, J. J. MacKenzie, L. Scheinman, and A. S. Schurgin

Cambridge: Union of Concerned Scientists; San Francisco: Friends of the Earth, 1974; v + 207 pp., \$4.95

Reviewed by Daniel J. Kleitman

Opposition to our nuclear power program runs a full spectrum from the emotional to the rational. There are memories of hideous destruction from nuclear bombs; exaggerated fears that we will poison life in the distant or not-so-distant future; reactionary or populist fears of new things and of the modern world; environmentalist conservatism; and irrational fear of nuclear disaster. These influences motivate much opposition and are a complete description of some of it. However, the movement has another component. There are a number of competent scientists who have dedicated themselves to scrutinizing every aspect of our nuclear activities and subjecting every detail they can isolate to the most rigorous rational analysis. They seem to do this in the name of opposition to nuclear power.

Whatever their motivation, they are performing a valuable public service. It is not possible for most of us to satisfy ourselves that the "A.E.C. experts" who make vital decisions affecting the future of the world are doing the job properly. On the other hand, if we can have conscientious, critical watchdogs who can locate the questionable and significant decisions for us and present the case against them, we may be able to follow the resulting controversies and formulate rational positions on them for ourselves. More significantly, the mere existence of the controversies has generally forced the Atomic Energy Commission to make the right decisions or to modify its decisions toward a national policy.

The Nuclear Fuel Cycle provides a good illustration of the positive gadfly role for such individuals as well as some of the polemic excesses one would expect in a discussion sponsored and published by committed partisans.

The Debate Goes On

The volume consists of six readable reports on problems related to the nuclear fuel cycle, along with a short foreword and publisher's note. Five of the six reports are scientific in tone and content, presenting reasonable cases for improvements in what have been the procedures and standards of the A.E.C. The cases are not necessarily overwhelming, but the mere existence of these arguments must force the regulatory agencies to accept the advocated suggestions or supply a convincing rebuttal. My own impression of the proposals is one of reassurance. Their adoption would be costly but not prohibitively so, and if these are the worst problems facing the nuclear age we need not fear it. If we weigh all our decisions carefully and act accordingly we will not destroy the world.

The storage and disposal of highly radioactive wastes — a problem that could in principle justify questioning the entire nuclear program — is the concern of the first report, by T. C. Hollocher. If we are generating power at a cost of accumulating wastes that will destroy the world in a few hundred or thousand years, we should have second thoughts; we could conceivably have second thoughts as well on the present program of denuding the world of fossil fuels or fissionable material, but we don't. Dr. Hollocher's analysis leads, in any case, to a far less drastic assessment.

In particular Dr. Hollocher notes that if transuranic elements were almost completely removed from the wastes (which might lead to a 2 to 3 per cent increase in the cost of delivered nuclear power),

the remaining wastes would be dangerous for perhaps only 800 years. Solidification and disposal — probably in deep geological formations — should follow, and research should be extended or continued on possible storage alternatives, such as under the Antarctic ice cap. He advocates stainless steel rather than carbon steel tanks for short-term storage. Apparently following these recommendations would satisfy him.

The second report, by Lawrence Scheinman, concerns nuclear safeguards — the problem posed by the possibilities of diversion of nuclear material to bomb-making or other antisocial purposes.

The safeguards problem is really three separate problems, one international and two domestic. The first involves diversion of material, the second sabotage, and the third our vulnerability to war damage. Dr. Scheinman's report refers only to the diversion problem, which internationally is already out of our control. Diversion of nuclear material to bomb-making has occurred — in violation of an agreement with the reactor fuel supplier — in India, and one can detect no movement aimed at punitive sanctions against India for this act. It is thus difficult to trust in the success of future international efforts against diversion. There is no connection between this and our domestic atomic energy program, though it ought perhaps to affect our encouragement of atomic power abroad.

The domestic safeguard problem is not trivial, since it is hard to define a level of attack against which we should seek safety and not much easier to defend against inside material diversion than against bank embezzlement. Measurement problems render auditing difficult, and laws and doctrines related to use of violence by guards are weighted toward preserving life over safeguarding property — even when the property is as potentially dangerous as nuclear materials. Yet with sufficient effort the problem seems solvable. The number of locations at which directly fissionable material will be available for theft will not be very large in the next few years, and it is reasonable to

believe that adequate safeguard plans and procedures can be worked out in that time given any well-defined standards — although they do not yet exist.

A history of the use of "tailings" (material separated from uranium ore in milling) by Dr. Hollocher and John J. MacKenzie describes the vast piles of tailings accumulated around uranium mills; they contain traces of radon — and it is not good to breathe radon. Some of these tailings were once used for fill in construction work, and now they release radon to the buildings over the fill. As a result, one extra case of lung cancer is expected per year — indeed a public health problem, but one of relatively meager proportions. If, for example, one compares this danger with David J. Rose's claim that a coal burning power plant kills 40 to 100 people per year through release of sulfur dioxide (see *February*, pp. 59-60), one wonders what could possibly be on the publisher's mind in citing this report as an argument for replacing nuclear power by alternate sources. And in any case, this use of tailings has long ceased.

In "Lung Cancer Among Uranium Mine Workers," Arell S. Schurgin and Dr. Hollocher marshal evidence that for centuries mining of radioactive material has led to lung cancer in miners, arguing that inhalation of radon or radon daughters is the culprit. In the 1950s and 1960s, miners working for eight years or more in U.S. mines having radon concentrations of more than 2.5 times current maximum standards — and who smoked — had the highest lung cancer incidence of all groups considered. Among the 35,439 white uranium miners up to the late 1960s (many of whom were exposed to radon before current standards existed), there were 44 more deaths from lung cancer than expected, several more per year. The paper makes a reasonable case for lowering the allowed radon level by a factor of at least four and perhaps more; if no changes are made there should be at least a convincing rebuttal.

A chapter on "Catastrophic Nuclear Accidents" by Daniel F. Ford and Henry W. Kendall refers to the area in which almost all A.E.C. effort concentrates — the safety of nuclear reactors. The problem here is one of considerable complexity, not much simplified here nor in recent documentation and debate. The one simplifying feature appears to be the likelihood that a disaster would involve core melting. In assessing the dangers of nuclear reactor catastrophe, one must thus determine the probability of an initiating accident; of safeguard devices failing to prevent core melt; and of the various modes of core melt that might arise, each with its own set of disastrous possibilities.

In August, 1974, the A.E.C. released a new study of the probabilities of all these events at two specific reactors (see *October/November*, pp. 14-15). The technical details of this study cover more

than 3,000 pages and yield reassuring conclusions. Ford and Kendall's report deals only with earlier safeguard studies. Only with a more current analysis can the authors refute these conclusions and help us to see what the argument is all about; as it stands this book mentions issues but lacks enough facts to present them.

Toward a Rational Balance of Safety

Some of these papers betray a certain carping criticism of the A.E.C. as if it had been a monster bent upon smuggling unsafety into its activities. It has been a bureaucracy, with a certain amount of institutional need to make its past decisions look sensible — but with a far greater dedication to safety than the authors credit. It is the proverbial complaint of industry that the A.E.C. incessantly upgraded its standards, usually requiring costly modification. Nor is industry opposed to safety; it is well aware that its own future depends upon compiling a good safety record. Its desire is that the regulators make up their minds on standards once and for all, let industry find its own ways to meet the standards, and keep a rational sense of balance and priorities in their safety analysis. But no human beings are perfect; errors, blunders, and unbalanced analyses have no doubt been made and will continue to be made by all parties.

One hopes that documents such as this one will prod the N.R.C., making it more likely that blunders will surface and be corrected before they do harm. But if the present volume must bear the burden of telling us why we must give up fission power, it in effect does the opposite. None of the papers could possibly lead to such a conclusion.

It is easy to attack some of these papers as nit-picking, subjecting nuclear power to a standard demanded of no other industry. On the other hand, our society holds human life to be precious. If improvements in practice or standards will save even a few lives, that is reason to give them serious consideration. Even if one can produce sufficient argument to reject the proposed improvements, it is only fair that the individuals involved be informed of the risks they take when they mine uranium, live over radioactive fill, or fish near a fuel reprocessing plant.

But there remains the question of mapping out the level of hazard presented by other occupations and human activities in the meticulous manner illustrated here, not necessarily to ban them but again so that we can decide on our own activities informed of their relative level of risk. The studies in this report have a flaw that, unfortunately, they share with most similar ones: The conclusions give a measure of the risk of several activities, but it is not one that we can relate easily to our own decisions. To know that of 30,000 miners 44 more than expected died of lung cancer does not tell the miner what risk he takes in going into the mine. If one could, with

appropriate assumptions, say that for each year in a mine at the maximal allowed exposure rate one expects reduction of life expectancy by a specified per cent, he could sense the meaning more easily.

A viewpoint such as this would surely lead us to emphasize some public health questions of far greater magnitude than nuclear power as it is today developed. For example, the shortage and high price of gasoline led to a reduction in the amount of driving after November, 1973, and a lowering of the speed limit. Across the country there was a dramatic reduction in the number of traffic fatalities — a reduction of perhaps 20 per cent or more for the first few months of 1974, more or less the number which might be lost in a very, very bad (though not the worst possible) nuclear disaster. There is room here for statistical analysis with very important public health implications.

The Devil and the Deep Blue Sea

There is one more disquieting note in this volume. The publishers in their cover remarks chide the A.E.C. for not having made or sponsored critical studies themselves. In an ideal world the A.E.C. would not only have sponsored such studies but would have hired or subsidized avowed critics and troublemakers; not to silence them, but to encourage them to devote as much skill and energy as possible to their criticisms. The A.E.C. should have forced its regular staff to answer the resulting criticisms in detail and maintain the resulting dialogue until the questions raised are resolved or clarified.

But this is not an ideal world, and the Union of Concerned Scientists (U.C.S.) bears at least some responsibility for the difference. When the A.E.C. published criticism of our nuclear program, it was publicly seized upon by the Fords and Kendalls to show that A.E.C. experts themselves find fault with what goes on. If instead the A.E.C. attempted to use self-generated criticism to spur its own investigations without first making them public, it was publicly denounced by the same critics for suppressing damaging information when the reports were ultimately made public (as they must be, since intervenors can subpoena them). As a direct consequence of this pressure by U.C.S. and similar sources, it became difficult for ordinary bureaucrats in the A.E.C. to encourage written criticism. Even the inspired and courageous officials were hindered in their actions by the expectation that criticisms they solicited would ultimately be torn out of context and used as publicity bludgeons against their organizations. Indeed, it is remarkable to me that the A.E.C. achieved as much as it did in encouraging criticism under these constraints.

It would certainly be disastrous if the new Nuclear Regulatory Commission were forced by U.C.S.-like pressure to

abandon its own self-criticisms, since U.C.S. resources are certainly insufficient for the task. And it would be a shame and an irony if such a well-meaning and competent organization as U.C.S. should on balance cause more harm than good.

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Environmental Architecture

A Bucket of Oil

William Wayne Caudill, Frank D. Lawyer and Thomas A. Bullock
Boston: Cahners Publishing Co., 1974, 88 pp.

Reviewed by Bruce Anderson

It's not too hard these days to be excited about a book on energy conservation, and in particular a very attractive book printed on what looks to be recycled paper and filled with nice photographs and simple architectural line drawings.

A Bucket of Oil builds on our own expectations, proposing to be "the humanistic approach to building design for energy conservation." Unfortunately, this book falls into a simple trap; although Caudill, Rowlett, Scott has been in business almost 30 years, its members set out to write and design this book with what seems to be limited knowledge about the basic issues and even less information about the topic in general. They also appear to be uninformed about what is going on today — the various projects demonstrating energy conservation principles, the advances being made in energy designs, the research underway and the legislation being passed.

Further, many areas of discussion are disarrayed in confused non-order. It is true that the issues of energy conservation are difficult to discuss in a linear way. But the pogo-stick effect of discussing first one aspect and then another and then another only to return again to the first, third, and second is extremely difficult to follow, and the issues are never brought together in one coherent and understandable whole.

"Simplicity is the most deceitful mistress . . ."

The book is hamstrung by oversimplification. For example, on page 12: "Solar Light Control: Daylighting Saves Energy." This is not necessarily the case. Often, the glass needed to admit daylight loses more energy to the cold outdoors than it saves in artificial lighting. Discussion of the choice of window glass — whether 1/4" plate glass, double pane insulating glass, or reflective or absorptive glass — is done only in the context of the

reduction in summer heat gain. The important issues of facade orientation or variation in heat gain required by different types of buildings for different times of the year or in different parts of the country are ignored.

The authors list "six simple guidelines" that can save energy, and only here do they mention the complexity of designing for energy conservation. But it's only a mention, and they go on to oversimplify the entire subject. They suggest using the climate to advantage by discarding generalized lighting for lighting systems designed for specific tasks, and by designing on the edge of the comfort zone so people can wear more or less clothing to suit their needs. And of course they refer to energy-efficient systems and controls for modifying unused spaces.

But they add that the building envelope (the outside of the structure) should be clean and sparse, that the more wall and roof area the more energy is required, suggesting that the minimum surface area building — a square box — would require less energy than a rectangular one. But this is not necessarily the case. For instance, a rectangular building can more readily use natural lighting around the perimeter — and that *can* save on electric, artificial lighting. Further, a long south wall in cold but sunny climates can admit sun during the day to relieve the burden on the heating system.

There are not just six simple guidelines but a hundred — none of them simple.

Power to the People

A Bucket of Oil emphasizes efficiency and economy as a means of obtaining best energy conservation designs, but nowhere does it suggest that buildings must be designed to encourage participation on the part of the users to conserve energy. Nowhere does it argue that systems be designed to allow people to operate them — windows, insulating shutters on the interior, thermostats, lights.

C.R.S. promotes the continued centralization of our sources of energy, removing the user even further from control of his own environment. In fact, the book asserts, "We must use solar and wind power even more in the future, but on a more centralized basis." Haven't the authors heard that solar and wind energy is already distributed? Why centralize it in large "solar farms"? This may be one alternative, but there are important arguments for decentralization of our power and energy production, as natural forms suggest, not its opposite.

And so perhaps the most significant omission in this spirited attempt to discuss energy conservation and building design is the basic definition of the building itself.

A building is a man-built environment that houses some sort of activity and that provides life-support systems in concert with one another when natural support systems are not sufficient. Energy is not



HOW TO START YOUR OWN BUSINESS

edited by
William D. Putt

Published in
cooperation with
the MIT Alumni
Association

\$9.95

This book is a collection of the experience and advice of entrepreneurs and of the men who worked with them and gave guidance in the financial and legal areas. The many examples of success and mistakes presented in this book should give prospective and practicing entrepreneurs an idea of the excitement, as well as the struggle, to be encountered in a new business.

Among the many questions answered in this book are the following: How do you know if the idea you have for your own company is a good concept? How much ownership should you relinquish to your partner or partners? How should you write a proposal to raise money? What are the different ways to structure a financial deal with your investors without giving away your company? What financial records should you maintain to manage your business? How do you sell a new product? These and many other topics are presented with a candor and lack of mythology that make the book exciting to read as well as informative.

The book grew out of a series of seminars and workshops put on by MIT entrepreneurs and others for MIT alumni interested in starting their own companies. The subjects presented reflect the interests and questions of several thousand entrepreneurs who attended these seminars. The book is published by the MIT Alumni Association and distributed by The MIT Press. William D. Putt received his Ph.D. from MIT and is president of Holograph Corporation, a company that he cofounded.

The MIT Press

Massachusetts Institute of Technology
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the only consideration in saving a bucket of oil. There are issues of food: provision, growing, harvesting, storing, and preparing; of water management: collection, control, and purification; of waste management: decreasing waste, returning it to the soil, and using it for energy; of transportation; of communication; of education; of people.

One hopes C.R.S. has learned a lot about energy conservation by preparing this book and in the future will consider buildings in the broadest context of environmental planning, taking into account not only energy savings but all other forms of life-support systems as well. Architecture, a dying profession, must expand its horizons from a wholly aesthetic/form/goal-oriented endeavor to one dedicated to providing people with meaningful environments that fully enhance the experience of living and that allow us to discover who we are in the context of the total world and the natural environment.

The author, who holds three degrees from M.I.T. (B.Arch. and S.B. in Aero. and Astro. '70, and M.Arch. '73), is Principal in the firm of Total Environmental Action, building design, planning, and consulting, of Harrisville, N.H.

Letters

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Should This Trip Be Up, Not In?

It seems to me that our cities need to go up, not out, in order to save commuting (see "Is This Trip Really Necessary?" *December, 1974, p. 64*). A cluster city might have, say, eight skyscrapers possibly arranged around a park one-quarter mile in diameter. Each would have a purpose: offices, apartments, schools, recreation, medical, shopping, light fabrication, and car rentals. Surrounding the cluster would be tennis courts, soccer fields, garden plots, etc., for at least five miles. While currently people may prefer to "live away from work," they currently "live away from play" too. As car prices, gasoline prices, parking costs, and travel times increase, the idea of riding an elevator to work or to a tennis court gets more and more appealing. For vacation or trips to the next cluster city, one could rent a car.

This concept has been started in Washington, D.C., where apartments are now being built next to offices. Adding the buildings for other purposes could come soon — and would require, I might add, a lot more thought on *balance* than I have given it. And some thought on how to use two extra hours a day, too.

Alan Pope
Albuquerque, N.M.

Butchering Medicine

As a Doctor of Medicine and Surgery, I deeply resent the headline "Science Comes to Medicine — Slowly" by Mr. Victor Cohn (*December, 1974, pp. 8-9*). There is much more to the "science of medicine" than the randomized double-blind controlled study that Mr. Cohn holds as his paragon of knowledge and truth. Dismissing all who came before Mayo as bumbling butchers crazed by the thrill of the knife does a disservice to a profession that since ancient times has led the attempt at finding scientific explanations for natural happenings and whose literature is probably the most voluminous ever recorded. Journalism's "scientific accomplishments" should only hope to be as great.

Joseph F. Adolph, M.D.
Washington, D.C.

The headline is the editors' — not Mr. Cohn's — responsibility. — Ed.

Nisbet

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about this phenomenon. However, in man — although tissue levels of DDT appear to have reached equilibrium some time ago — those of DDE rise constantly with age — an observation hard to reconcile with the equilibrium theory.

Worst of all, laboratory studies now seem to underestimate grossly the potential for ecological magnification in the natural environment. In Lake Michigan, for example, the average concentrations of DDT and dieldrin in the lake water are in the range of 1 to 3 parts per trillion. Typical concentrations in fish are in the range of 0.2 and 10 parts per million, representing ecological magnification factors of roughly 3×10^6 and 10^5 , respectively. Yet under experimental conditions ecological magnification factors for these chemicals in fish rarely, if ever, exceed 10^5 and 5×10^3 , respectively. Evidently some phenomenon leads to magnification 20 to 30 times greater in the wild than in the laboratory. Many similar examples could be cited involving unexpectedly high concentrations in wild fish, birds, and mammals.

One factor contributing to these anomalies is that the chemicals are distributed patchily in the environment and tend to be concentrated in biologically productive areas (e.g., sewage effluents or natural surface slicks). Predatory animals tend to concentrate their activities in such areas, and they thus selectively expose themselves to high levels of pollutants. Probably a more important factor is selective predation: It is well known that predators selectively take prey whose behavior is abnormal, and several studies have shown that they tend to select prey with above-average residues

of chlorinated hydrocarbons. Selective exposure is a particular hazard to scavenging animals — those which eat dead or moribund prey — who are thus in danger of selecting poisoned individuals. We urgently need more critical study of these processes. However, it is becoming clear that ecological magnification of toxic chemicals is a phenomenon ultimately controlled by ecological variables and not by the physiological or physicochemical factors usually studied in the laboratory.

Ian C. T. Nisbet, who writes regularly for Technology Review, is Associate Director of the Scientific Staff of Massachusetts Audubon Society; he is a graduate of Cambridge University, England, in physics (Ph.D. 1958).

Purcell

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and N. Richard Werthamer, solid-state physicist from Bell Laboratories, were sponsored by A.P.S.; and Ronal Larson, Associate Professor of Electrical Engineering at Georgia Tech, joined as an I.E.E.E. fellow.

By the time these fellows arrived in Washington in September, Dr. Hyman, the A.S.M.E. fellow who had been with the Senate Commerce Committee staff since early spring, had clearly demonstrated that a technical person on a fellowship basis could make significant contributions to Congressional staff work and win the respect and admiration of his peers. Dr. Hyman had become an energy conservation expert for the staff, the organizer of an important energy conservation hearing held before the Committee several months before the "energy crisis."

The tension that preceded the arrival of the new Congressional fellows gave way during their two-week orientation to a free exchange that revealed a lot about the curiosity, misconceptions, and mutual interests of the new fellows and the "old pols." One Congressman's administrative assistant reminded the fellows that their presence probably meant a tripling or quadrupling of the total technical staff capability of Congress. A veteran staff member warned them, "As outsiders, don't expect to accomplish much. You'll probably spend most of your time addressing envelopes and answering constituent mail." A Senator beamed and said, "We need you. You're welcome with open arms."

The fellows, having a snappy two-week cram course in the institution they were about to serve, learned that privacy does not exist if you work in Congress and that the quiet office or laboratory from which they had come would only be something to dream about over the next several months.

Assignments were determined after a thorough process of interviewing and negotiation. Ben Cooper and Mike Telson went to Senator Henry Jackson's Committee on Interior and Insular Affairs; Ms. Tuchman joined the staff of Representative Morris Udall's Environment Subcommittee of the House Interior and Insular Affairs Committee. Elliot Segal chose the office of Senator Warren Magnuson; Ron Larson joined the House Committee on Science and Astronautics, and Dr. Werthamer became associated with Representative Charles Mosher.

Technology and Policy for Energy and Health

What have these scientists and engineers accomplished? How do they and their colleagues view their efforts? Start with an observation of Dick Werthamer's: When you're talking about a scientist or engineer working in Congress, you are talking about someone there to assist, not advise; to deal with technology in contrast to science.

The fellows have dealt with many subjects outside the areas of their technical training. They have functioned as resident technological generalists, called upon to analyze, interpret, or formulate technical and semi-technical input on a host of issues pertaining to proposed bills, policy statements, background papers, speeches, and briefings. Drs. Cooper and Telson made substantial contributions to the work of the Senate Interior Committee, the principal Senate body concerned with the pressing national issue of energy supplies and energy policy. Dr. Cooper wrote several portions of the Committee's "National Energy Information Act" as well as a widely distributed committee print titled "An Assessment and Analysis of the National Energy Emergency." Dr. Telson became a staff expert on energy pricing policy and wrote a key committee print on this subject. Dr. Tuchman worked on such matters as land use, energy shortages, and energy resource development, and wrote sections of Representative Udall's land-use bill which was narrowly defeated this past summer. Mr. Segal quickly established himself as the health policy analyst in Senator Magnuson's office, working with the Commerce Committee on several health- and safety-related issues, including no-fault insurance, and helping with Senator Magnuson's book on the state of health care in the U.S. Dr. Larson served as the solar energy expert of the House Committee on Science and Astronautics; besides arranging and executing extensive hearings on this important subject, Dr. Larson contributed heavily to that Committee's bill known as the "Solar Heating and Cooling Act." Dr. Werthamer, assisting Representative Charles Mosher in his new position as Vice Chairman of the Office of Technology Assessment, helped establish the working policy of that new enterprise.

No Clearer Proof of Washington's Need
Now, well over one year later, although the fellowship periods have ended, a combination of what Washingtonians call "Potomac Fever," enthusiasm for Congressional scientific work, and high marks from their peers have kept nearly all the first fellows on "the Hill" in continuing part- or full-time capacities. Dr. Hyman, the first full-time fellow, extended his stay by several months to serve as chief staff person for the Research and Development Subcommittee of the Commerce Committee; while he has since returned to teaching, he maintains a part-time consulting status with the Commerce Committee staff. Ms. Tuchman is staying on as a member of the House Interior Committee staff; Mr. Segal has left his post at Yale's Medical School to continue work with Senator Magnuson and with the National Academy of Science's Institute of Medicine. Dr. Werthamer, although officially back at Bell Labs full-time, has been spotted by this author back in Washington conferring with Emilio Q. Daddario, Director of O.T.A. Dr. Larson delayed his return to Georgia Tech by one year to direct O.T.A.'s solar energy project. And Dr. Telson has taken a key staff position with the new House Budget Committee.

There is no clearer proof of the ability of scientists and engineers to make significant contributions to the country's legislative process than the success of these men and women. They have shown that "outsiders" with scientific background can be accepted into an exclusive club of lawyers, and the programs which sponsored them have proved a viable method of placing scientists and engineers in sensitive Congressional positions without the intention of lobbying for vested interests.

The Hazard of Conflict of Interest

The programs have a bright future, though two major obstacles lie in the path of needed expansion. One is money. As the A.A.A.S. has learned, success does not necessarily lead to the loosening of purse strings; hence, while a two-year Ford Foundation grant is fully funding three O.T.A.-based A.A.A.S. Fellows during the current year, only shorter term partial funding could be obtained for other Fellows. Several other professional societies interested in programs of this sort are hard pressed to fund them. Although the American Physical Society, the I.E.E.E. and the A.I.A.A. (American Institute of Aeronautics and Astronautics) have been able to sponsor a total of six fellows for the '74-'75 year, much of the funding problem is related to the specter of conflict of interest, the second major obstacle to expanding Congressional fellowship programs. Will foundations or other groups who fund fellowships be accused of trying to influence the course of Congressional decisionmaking?

The value of these Congressional science and engineering fellows to the national interest dictates that these obstacles must be surmounted. One member of Congress has suggested that the recurrent problem of Congressional impotence has its roots in the lack of technical expertise: "Lacking the scientific resources available to the Executive, the Congress has become overly dependent on the Executive recommendations and reports. As a result, the Congress can often do little but ratify decisions which it does not always properly investigate or understand." If our technical community can work to ensure that fellowship programs flourish and grow, it can do much to ensure that Congress will always have the resources it requires to understand the technological nation it serves.

Arthur H. Purcell whose professional field is materials engineering, was formerly Associate Director of the A.A.A.S. Congressional Scientist-Fellow Program which is the subject of this report; he is now a private- and public-interest consulting engineer in Washington. The A.A.A.S. has recently announced the 1975-76 Congressional Fellow Program, with applications due on or before March 31; for information, write to Dr. Richard Scribner, Director of the Program, 1776 Massachusetts Ave., N.W., Washington, D.C., 20036.

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Why are so many inventors so frustrated so much of the time? Because the success of their inventions depends far less upon the inventions themselves than upon the channels that connect them with their market. In 20 words, that is the lesson read by four faculty of the Sloan School of Management to a midwinter seminar on technical innovation at RCA's Sarnoff Research Center in Princeton, N.J. The pictures show (top) S. James Goldstein, President of the M.I.T. Club of Northern New Jersey, with Edward B. Roberts (right), Sarnoff Professor of Management; and (bottom) Abraham J. Siegel, Associate Dean of the Sloan School, with William Webster (right), Vice President of RCA Laboratories.

Innovation: How to Have It and How to Keep It

To maximize the innovative achievements of your research and development staff, pick scientists and engineers with highest technical skills, give them plenty of chances to interact with each other, make sure the marketing department and perhaps even the customers can put at least a word in edgewise, and make it clear that creativity is rewarded in financial as well as in subtler terms.

That's the substance of the advice from four members of the Sloan School of Management conducting a management seminar this winter at RCA's Sarnoff Research Center in Princeton.

Innovation Correlates with Pressure, Freedom, and Innovation

The organization chart doesn't tell much about how a research and development laboratory operates. A much more important issue, thinks Professor George F. Farris, is who talks to whom, how ideas flow through the suggestion, proposal, and solution stages of the innovation process. No two engineers are alike. One is a thinker; the next one is an evaluator; another is a listener; still another is a "walking handbook" of useful information.

In most laboratories, thinks Professor Farris, there develops an informal organization of people working with people on the basis of these special qualities which is quite apart from any formal structure shown in organization charts and project assignment. And the successful research and development manager is the one who can recognize and capitalize on this kind of *ad hoc* pseudo-organization.

How? No certain answer, says Professor Farris, because — even after considerable research on the subject — he finds himself confronted by the dilemma of the chicken and the egg. Engineers in innovative research and development groups will more often cite their supervisor for administrative than for technical contributions. But it is also true that the supervisor of a group whose innovative record ranks high is likely to himself be a skillful, innovative technologist. Is the group in fact

succeeding because of its supervisor's skills, or is he in fact motivating the others to perform at top capacity by being an effective administrator?

The correlation between high technical skills in the supervisor and high performance in his group is the strongest that Professor Farris has found in studies of research and development laboratories. There is a somewhat less positive correlation between a group's innovation and the freedom granted by its supervisors, and this correlation is especially strong if the supervisor is more highly qualified as administrator than as technologist. The moral: If the boss doesn't know the technical details, let him keep out of the way of those who do.

What about time pressure? "A strong positive correlation" between time pressure in the form of tight schedules and innovative performance, says Professor Farris. Recognition and advancement — attributes of an organization assured by an effective administrator — are important too.

Taking Some Noise Out of R & D Communications

Among the many different roles of those in the informal organization of an innovative research and development department, none is more important than the "gatekeeper." Professor Thomas Allen identifies him as the key figure in a key function: how to keep research ahead of the information explosion.

Only a few able technical people read the journals; indeed, Professor Allen — studying the information flow in several research and development groups — finds that only 10 per cent of it enters in written form: magazines, papers, and manuscripts. And the ideas that were credited in some way to written communications were less useful than those that were credited to "inside," non-written sources. Obviously what Professor Allen calls a "noisy channel" is at work, and — convinced of the correlation between information and innovation — he has sought a way to remove some of the noise.



Salvador E. Luria, Institute Professor who directs M.I.T.'s Center for Cancer Research (he holds the Nobel Prize in Medicine for 1969), takes both pleasure and pride in introducing M.I.T. undergraduates to the biological sciences each year. Now his series of 36 undergraduate lectures has been published by the M.I.T. Press; and the photograph shows President Jerome B. Wiesner visiting with Dr. and Mrs. Luria at an author's reception.

That search led him quickly to the "gatekeepers" concept: There are in every research and development organization a few notably effective communicators. They read, they write letters, and they talk to their colleagues both inside and outside the laboratory. They are perhaps 10 per cent of the population of any particular group or laboratory; they are often first-level supervisors — in a position to know what many people are doing but not so highly placed as to be out of reach.

They are indispensable, thinks Professor Allen, and — once you realize they exist — readily identifiable. Some advice to research and development managers who would capitalize on these unique people:

- Reward them, at least indirectly. If a direct reward involves a promotion, try to see that some other "gatekeeper" is positioned to replace the one whose effectiveness may have been jeopardized by his new, higher responsibilities.

- Look for places in the organization chart for "gatekeepers" that will encourage communication; as "communications multipliers" such people might head task forces, lead seminars and training sessions, have more chances to attend meetings.

- Give "gatekeepers" key, central locations. Professor Allen's studies suggest that communication in a research and development laboratory is "very, very sensitive to distance." The probability of communication between two people is very much greater if their desks are less than 50 ft. apart — much less if they are around a corner or upstairs, one from the other.

How Can Research Learn Enough About the Territory?

Given the laboratory staff and its communications, what factors most promise success for a research and development task? Professor Eric Von Hippel answers that question with a single word — the market.

Of successful projects in a series he has analyzed, the stimulus for 75 per cent was user-need. Only 25 per cent originated in a technological opportunity envisioned

and later exploited by the laboratory itself. The implications are obvious, if the results hard to achieve.

Problems:

- How often does the research and development staff have lunch with the marketing staff? (They're often not within 50 miles of each other, and they often talk almost totally different languages.)

- The marketing staff is trained to think in terms of fast deliveries; research and development in terms of thorough, pains-taking research.

- Even at best it's hard to identify need, because most of us tend to hide our problems and extemporize solutions. "There is no package that reads, 'Fresh need — this side up,'" says Professor von Hippel; "you have to know the territory." "Vague dissatisfactions" may be a clue, and for lots of companies the home-made prototypes among scientific instruments in their customers' laboratories — and their own? — may be good sources of ideas.

Perhaps need can be better identified if you think in two categories — needs for services or devices to do jobs that can't now be done; and needs that are expressed in terms of improvements over existing solutions, such as greater accuracy, faster, cheaper.

When a New Venture Is the Consequence of Success

The penultimate product of innovation is entrepreneurship — a new venture. The problems, risks, and opportunities are all multiplied, and so are the options.

Edward B. Roberts, who is Sarnoff Professor of Management at M.I.T., has spent most of two decades studying entrepreneurship; no accident that he holds the professorship designated to further the study of research management at M.I.T., and no accident that he was chosen for the finale of a management seminar at R.C.A.'s Sarnoff Center. For new ventures combine all the problems and risks of exploiting research in terms which are often not miscible:

- A new venture generally pushes an entrepreneur or his company into new experiences.

- The success will depend not only on

technology but on several issues of management as well.

— A new organizational form will often be needed.

Approaching this arena, a company that wants to exploit a new and different innovation with only modest risk to its established lines of action can spin off its new brainchild into a semi-independent enterprise, or it can turn its innovators into a new organization within the company. The former is traditional, but the latter — especially as practiced by 3-M Co. — most intrigues Professor Roberts. It's a plan that he thinks might well be studied by other firms whose goal is to "enhance internal entrepreneurship."

The key to the system is independence and responsibility — a kind of industrial manifestation of the "every tub on its own bottom" concept of university management typified by Harvard. In a nutshell, anyone at 3-M Co. who believes he has a marketable new product concept is free to look throughout the firm for encouragement. When he finds it, he can put together a "product team" consisting of talent in marketing, production, and finance, and the 3-M management will keep the team together while it tries to prove itself. It's worked, thinks Professor Roberts; 3-M seems to have what every member of the M.I.T. group at Princeton was trying to help others achieve: "a corporate environment providing credibility to the entrepreneurial philosophy and motivating ... entrepreneurs." — J.M.

Food vs. Population: Will They Ever Balance?

In a time of food shortage, everyone's instinct is to ask food-rich people to help hungry people. But Professor Jay W. Forrester, whose computer-based models have convinced him that social systems often exhibit counterintuitive behavior (see *Technology Review for January, 1971*), thinks this may be another example.

"It is not at all clear that increasing the food supply will prevent starvation [in the

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long run]," Professor Forrester told an M.I.T. seminar on international development early this winter. "It is entirely possible that we are chasing our tails."

Professor Forrester's suspicion — on which Dale Runge, one of his graduate students, is working — is that "no matter how much food you have, population will overrun it." If the world works according to such a model, he said, distribution of food from "have" to "have-not" nations will help in the short run. But in the long run, food assistance programs may serve only to keep alive even larger populations so that in the end "everyone runs out of everything simultaneously — a way of stretching the rubber band tighter and tighter," said Professor Forrester.

Nevin S. Scrimshaw, Professor of Human Nutrition at M.I.T. who is a leader in international food programs (see December, pp. 12-19), was dismayed. "The danger in developing a model like this is that it seems to make the outcome inevitable," he said. It denies the possibility of more efficient agriculture, improved nutrition, better population control. "It can give government an excuse for inaction," and for all these reasons "it is likely to become a self-fulfilling prophecy," declared Professor Scrimshaw.

"Inaction can be a very positive course, compared to one which is harmful," replied Professor Forrester. "The old saying, 'Don't just stand there, do something!' is often a very devastating piece of advice."

Observing by Computer Instead of by Eyepiece

"The most automated optical telescope yet developed for general use" is now in operation at M.I.T.'s George R. Wallace, Jr., Astrophysical Observatory in Westford, Mass. The telescope itself is small — 24 in.; it is distinguished not by its power but by the power of two computers linked with it in a system which, its designer believes, will be significant as a prototype for controlling large, multi-million-dollar telescopes. The Wallace Observatory system was built for \$150,000.

It's handy and simple. The astronomer works at a console instead of with an eyepiece. For example, the computer presents to him at his console a list of celestial targets the telescope can be prepared to observe. The astronomer uses an electronic pointer to select one object; the telescope is then automatically moved to the object, tracks it, and records data according to the astronomer's instructions.

Professor Thomas B. McCord, who conceived and designed the system, thinks it holds the key to substantial gains in telescope efficiency and hence economy. "Even a factor-of-two improvement in the efficiency of using a \$10-million telescope," he says, "is in many ways equivalent to building a new telescope."

Alumni Days 1975

Celebrate the Alumni Association Centennial
on June 5 and 6 and the Bicentennial in Boston

THURSDAY
JUNE 5

Travel to Boston

8:00 (P.M.) - Buses leave M.I.T. for
Symphony Hall

8:30 - Arthur Fiedler conducts the
Boston Pops

FRIDAY
JUNE 6

8:00 - Coffee and Pres. Wiesner's welcome

9:30 - Panel (Rosenblith, Press, Schon, Tribus, Solow)

11:30 - Memorial Service (Chapel)

12:00 - Box lunch. O. Piene's "Visual happening"

1:30 - Class gift (Kresge)

2:30 - Demonstrations and lectures by departments

5:30 - Cocktails (Sala de Puerto Rico)

SATURDAY
JUNE 7

SUNDAY
JUNE 8

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Here is a report on an in-depth survey of 489 M.I.T. graduates — “a tapestry of opinions and views which . . . may help to forge a stronger relationship between the Institute and the men and women who were once its students”

An Adventure in Understanding Alumni and Their Alma Mater

This report is an account of an extraordinary experience — that of visiting, by telephone, with a representative sample of several hundred M.I.T. alumni across the country. Each visit — always by appointment and lasting an average of 53 minutes — was an adventure in evoking and listening to attitudes, opinions, suggestions, and criticisms about the Institute.

The alumni survey which we describe on the following pages was a natural outgrowth of a project started early in 1973 to study the effectiveness of M.I.T.’s efforts to communicate information about its programs and activities to groups outside the immediate Institute community. Obviously, alumni were a key audience in

developing this picture. Through discussions with many alumni and people at M.I.T., we came gradually to a plan for a survey based on meaningful dialogue with a representative group of the Institute’s graduates.

We concluded that a discussion format was needed, in which alumni would have an opportunity to express their views in their own words and to clarify their opinions. We needed not only the “pro” and “con” positions of alumni on various issues; we needed to understand, if we could, the reasons behind their attitudes. These considerations ruled out a conventional questionnaire which asked for “yes/no” or “agree/disagree” responses. Our planning therefore proceeded on the premise that the survey would be conducted using personal interviews.

The purpose of the survey was to listen to and learn from alumni, so that we might gain a better understanding not only of alumni feelings and perceptions, but, in a way, of the Institute itself — for M.I.T. surely can be measured by the contributions it has made to the lives of those who studied and worked here.

Our main sample included 489 alumni residing in the continental U.S. and Canada, selected randomly from files maintained by the Alumni Association; it was proportionally stratified in terms of year of graduation, and whether the alumnus had been an undergraduate student or had attended M.I.T. *only* as a graduate student. In addition, because of their relatively small proportion in the total alumni population (and therefore in our main sample), we randomly selected special samples from some special groups within the total alumni population — women, recent black alumni, and the alumni leadership groups. This brought the number of respondents to 738. This report will be on the main sample of 489 *only*, representing the overall views of the alumni population. We are still studying the additional special samples.

A Series of “Engaging” Conversations
Alumni in the sample first received a letter from President Wiesner explaining the nature of the survey and asking for their

participation. This was followed by a telephone call from a member of the Alumni Survey Study Group to schedule an appointment. If the alumnus or alumna agreed to an interview (and most did), a time was set. (If we were unable to schedule an interview, we replaced that alumnus with another from the same subgroup population, so that the representativeness of the sample was maintained.) Then at the appointed hour the respondent was called by one of 30 specially-trained interviewers; five of these were alumni volunteers. The interviewers used a written interview guide which defined some general areas of discussion and provided some value-neutral questions with which to open each area. We felt that if we opened a general area, and then listened, we could learn more than if we proceeded quickly to a series of specific questions.

The interviewer wrote down on the interview report the respondent’s exact words, with no paraphrasing, and noted in the margin if a particular response was given with a higher-than-usual intensity of feeling. Once a general area had been opened, the interviewer was responsible for probing further for clarity and understanding, using such neutral questions as “Do you mind telling me why you feel that way?” or “I’m not sure I understand; can you give a specific example of that?”

The interviewer’s primary responsibility was to listen in a “neutrally responsive” way, and to record faithfully what was being said. Respondents were not discouraged from initiating discussion in areas in which they were interested, irrespective of the order in which those subject areas might appear (if at all) in the interview guide. Therefore, the interviewer had to be prepared to follow the respondent’s train of thought, wherever it went. Respondents were thus encouraged to raise whatever issues were on their minds and to tell us not only what they were thinking, but why.

Throughout the fieldwork for the survey, one of the recurrent questions had to do with how we would preserve the richness of alumni views in a useful and manageable way. As one alumnus said at the

The following table shows the size and stratification of the sample used in the survey of the interests and attitudes of M.I.T. alumni which is described in the accompanying article.

Undergraduate classes: *	
1963-73	75
1952-62	77
1941-51	74
1930-40	51
Before 1930	49
Total	326
Graduate-School-only classes: *	
1963-73	63
1952-62	50
Before 1952	50
Total	163
Total sample	489

* Those designated as “undergraduate alumni” above — and throughout this report — include some who continued on at M.I.T. for graduate study. Those designated as “Graduate-School-only” alumni attended M.I.T. only as graduate students. The number of respondents in each of the subgroups is proportional to the representation of that group in the alumni population.

Kathryn W. Lombardi
Analytical Studies and Planning Group
M.I.T.

David S. Wiley, '61
Analytical Studies and Planning Group
M.I.T.

Constantine B. Simonides
Vice President, M.I.T.

end of his interview, "You've done a good job of covering it all, and I hope my answers help. I imagine you'll just throw it all into the computer."

We have, in fact, relied on computer processing as one tool to help us organize the 650 hours of spontaneous and thoughtful discussion that were the heart of the survey. As noted above, however, the interviews were not succinct question-and-answer sessions and did not give us information in "byte-size" pieces. We were not trying to test a model of what we thought alumni views might be; rather we collected whole conversations and let that information suggest the clusters of opinion that emerged. What we report here are the patterns of opinion and viewpoint which were volunteered at many points throughout the interviews. The categories we report on were devised *after* the interviews, in order to distill and communicate what was said in an organized and representative manner. The statistical data presented here help to support and shape the profile of alumni views but do not by themselves capture the richness — the individuality, flavor, and shades of meaning — which came through the interviews and which we hope to convey in discussions of the findings.

Nothing resembling unanimity was found on any point in the survey. What did emerge from our study was a tapestry of opinions and views which sharpen our understanding of alumni and the Institute, a collection of insights that may help to forge a stronger relationship between the Institute and the men and women who once were its students.

In candid and open discussions, we learned what alumni tend to think about, as well as the range of their opinions on various issues. In some ways, the enthusiastic and thoughtful participation of so many alumni told us as much about their attitudes toward M.I.T. as did the particular things they had to say during the interviews. The warmth, and depth, and engaging character of the conversations, as well as their comments on specific issues, point out the high regard and good will most alumni have for M.I.T. And whether they like or dislike the Insti-

tute, approve or disapprove of recent changes, they often make a point of saying that M.I.T. is unique, and has a special character found nowhere else.

An Outstanding Faculty, but Do Students Get the Full Benefit?

Positive and often extremely favorable comments were volunteered about the reputation of M.I.T. by two-thirds of the respondents; only 2 per cent offered mixed or negative comments. Graduate School alumni were more likely than undergraduate alumni to volunteer a high regard for M.I.T.'s reputation. Generally, older alumni tended to make this kind of comment more often than younger.

Factors seen as contributing to M.I.T.'s high reputation included technical and scientific excellence, a tradition of innovation, high scholarship and discipline, and a special ability to contribute to the solution of major problems of national or worldwide import. This general recognition of M.I.T.'s prominence was often coupled with an expectation that M.I.T. would continue to be one of the world's outstanding educational and research institutions.

Alumni referred to the Institute most frequently as a scientific-, engineering-, or research-oriented institution; rarely did they speak of it as a college or university. There was a substantial expectation (discussed later) that M.I.T. should broaden its mission to bring its strength to bear more on the problems of modern society.

Almost one-third of the sample volunteered comment on the outstanding professional reputation of M.I.T. faculty members, with graduate school alumni volunteering significantly more comments on this topic. These comments on faculty reputation referred most often to faculty members' professional prestige and excellence in research.

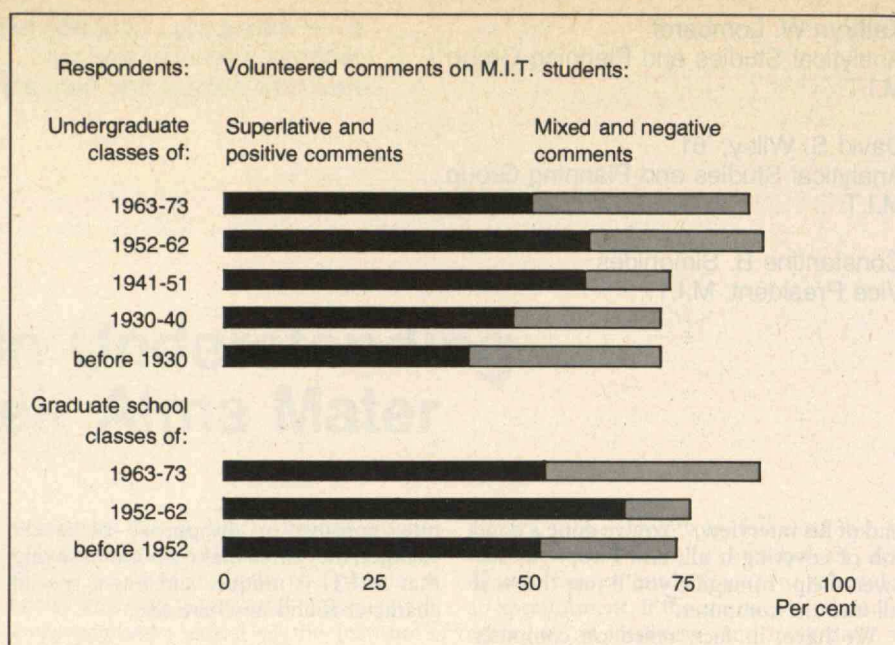
Regarding the quality of teaching and the nature of student-faculty interaction, however, the comments were more critical. Respondents did not always see students as the primary beneficiaries of the high caliber of the faculty talent. For example, more than one-quarter of the sample volunteered comment on faculty

interest in students or on the quality of teaching, and here the mixed or negative comments were twice as frequent as positive ones. Some who made positive comments liked the fact that faculty involvement in research brought the excitement of current research into the classroom; others talked about individual faculty members who had been particularly inspiring as teachers. Some of the more unfavorable comments, on the other hand, referred to faculty members' inaccessibility, to a perceived emphasis on research at the expense of teaching, and to a lack of competence or caring as advisors. "The instructor was a genius but he just flew through the material and left us in the dust; too smart to be a good teacher," said one alumnus.

Over three-quarters of the respondents offered some comment on the quality or character of M.I.T. students — with twice as many giving positive or very favorable, as distinct from mixed or negative, assessments. Alumni views of M.I.T. students included their impressions of students currently or recently at M.I.T., as well as their reflections on their own student days. On the whole, attitudes expressed about recent or past students appeared to be about the same. On the positive side, M.I.T. students were typically viewed as extraordinarily intelligent, capable, serious, and well-prepared. Some alumni recalled the unsettling experience of entering M.I.T. as freshmen and finding themselves surrounded by what appeared to be nothing but geniuses and class valedictorians. One alumnus recalled,

"I'd just like to feel closer to M.I.T. and have the feeling that someone there cares that I still be a part of the community."

More than three-quarters of M.I.T. alumni surveyed offered some comment on the quality or character of M.I.T. students, and twice as many made positive or very favorable comments as gave mixed or negative assessments. The predominant theme was that M.I.T. students — present, recent, or past — are extraordinarily talented and bright, and that judgment varies little between older and younger alumni.



“When I arrived, I was impressed with myself. Shortly after, I was impressed with everyone else and worried about myself.”

Those who made critical or negative comments often suggested that, while M.I.T. students were technically and professionally capable, they sometimes lacked qualities of breadth or leadership — including an interest in broader issues outside the laboratory or classroom. Whether this was seen primarily as a characteristic of the students themselves or of the Institute’s educational program was not clear. There was, however, frequent comment on the hard work ethic prevailing among the student body — an orientation that tended to focus students’ interests, time, and attention on the development of exceptional capability in a particular field, but which did not foster a great deal of speculative or introspective thought. In the words of one respondent: “Work dominated things and limited the exploration of relationships. I wondered how people felt about other people.”

Pragmatic Assessments of the Value of an M.I.T. Education

In order to gain an understanding of what M.I.T. has meant to alumni, we asked two direct questions on this topic: — How important is it to you that you studied at M.I.T.?

— If you were of college age today, would you choose to come to M.I.T.?

The answers to these questions, as well as the comments volunteered throughout the interviews, portrayed dimensions of life at M.I.T. which are not planned into the curriculum or residential program, but which are significant forces in the education of M.I.T. students and powerful shapers of their lasting impressions.

For every alumnus who indicated that it was of little importance to have studied at M.I.T., there were about three who thought it was somewhat important, and

eight who judged it very important that he or she had done so. The only alumni who seemed to show any significant deviation from this overall pattern were the undergraduate alumni who were here during the 1950s. Only about half of this group attached high importance to their having studied at M.I.T., as compared with an average of over two-thirds for the other groups of undergraduate alumni.

Most alumni tended to make quite pragmatic assessments of the value of an M.I.T. education; that is, they talked most often of its contribution to their professional careers and much less often of a general widening of intellectual horizons or a deeper understanding of self and of the world around them. “I like being associated with the school’s reputation,” said one respondent. “When you first get out, it is helpful in getting started. What I learned in terms of how to solve problems — in using rational analysis and the tools of mathematics — was also very helpful.” Another was less specific if no less pragmatic: “M.I.T. did give me something: the self-confidence to know that however hard or seemingly impossible the task, I can do it.”

Having solid confidence in the value and credibility of an M.I.T. education, almost three-quarters of the alumni we talked to would probably come to M.I.T. again. Said one respondent: “If I were of college age today? I’d just grit my teeth and do it again.”

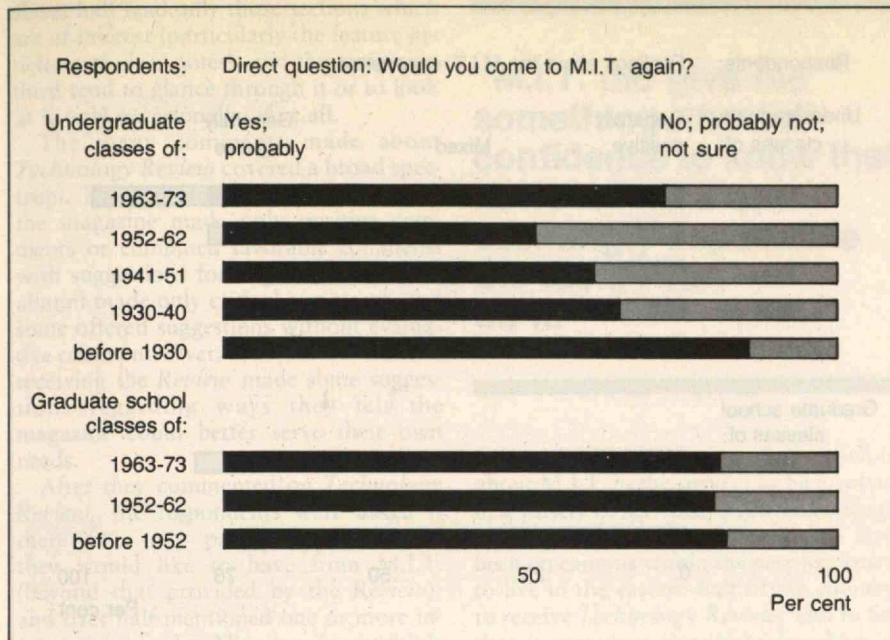
Alumni who attended M.I.T. only as graduate students were significantly more likely than undergraduate alumni to say they would come again (81 per cent vs. 66 per cent). A substantial portion of the graduate school alumni specifically volunteered that they would come again as graduate students but not as undergraduates. For some, the proverbial drink from the firehose seemed too much to expect of undergraduates. Said one man:

“The way undergraduates had the work piled on them, that seemed excessive. I told my children not to go. Despite that, my youngest daughter is there as a student, and is enjoying it immensely.”

As a rule, the high positive response to the questions on the importance of their M.I.T. education and on whether they would come to M.I.T. again was related to the quality and character of the academic and professional programs of the Institute. In fact, many alumni qualified their response by saying they would attend M.I.T. again if their career goals were the same.

Recalling the M.I.T. Experience

When feelings about the atmosphere and environment of the campus are considered, the picture becomes less favorable than that based on the academic program alone. To understand alumni feelings on the experience of being at M.I.T., we examined relevant comments volunteered throughout the interview. In addition, we made an overall assessment of the respondents’ feelings about their experiences at M.I.T. based on a total reading of the entire interview. From these various indicators we found that we could characterize the kinds of feelings most people had about their experiences while they were students at M.I.T. Our analysis shows that about one-third had generally positive memories, another one-third expressed mixed feelings, and about one-eighth expressed generally negative feelings about various aspects of their years at M.I.T. Among undergraduate alumni, generally positive recollections were shared more often by those from the older classes, whereas the more recent undergraduate alumni were more likely to express mixed feelings. Those with more negative memories often referred to the impersonality and coldness of the atmosphere (voluntary comments on the



If you were of college age today, would you choose to come to M.I.T.? Among undergraduate alumni there are significant differences by age in the answers to that question; people from the more recent and from the oldest classes seem to be the most enthusiastic. Alumni who were at M.I.T. for Graduate School only were highly positive in response to the question, though one-third of those in the Classes from 1952 to 1973 volunteered that they would come again as graduate students — but *not* as undergraduates.

impersonality and coldness of the M.I.T. environment were made by 12 per cent of the sample) or to excessive competition and pressure (voluntary comments on the pressure at M.I.T. were made by one-quarter of the respondents); some referred to M.I.T.'s "factory" image.

The pressure and competition, while regarded as a necessary condition for their academic preparation by some, were more often seen as having an adverse effect on the overall environment.

These recollections illustrate a tension that was apparent in the attitudes of many alumni toward M.I.T.: satisfaction or pride in being associated with an outstanding educational institution, coupled with some negative feelings about the impact of M.I.T. on their personal lives while they were students here.

Changes at M.I.T.

In order to solicit comments on M.I.T. today, we asked alumni what they thought about recent developments at the Institute over the last few years. We did not ask about any trends specifically; rather the trends we mention below are those brought up by alumni on their own initiative at any point in the interview. For this reason, the responses — characterized by diversity — indicate not only alumni opinions but also what alumni tend to think about when they consider changes at the Institute.

The subjects of most frequent comment were admissions (37 per cent); the academic program (49 per cent, including the development of the humanities and social sciences [28 per cent]); and research policy in relation to defense (22 per cent).

Among those who volunteered comment on admissions, there was consistent interest in maintaining standards and quality. One-eighth of all respondents specifically mentioned the importance of preserving what they saw as M.I.T.'s tra-

ditional elitism, and one-tenth spoke of the need to broaden the admissions policies in order to achieve a better mix in terms of students' interests and backgrounds. Support of M.I.T.'s efforts to increase the number of women and minority students was volunteered by one-fifth of the respondents.

About half of the respondents commented on one or more trends in the academic program, most often the broadened curriculum (to address, for example, connections among science, technology, and social issues); expansion of humanities and social science offerings; increased flexibility or attention to individual interests (including such changes as the Undergraduate Research Opportunities Program, pass/fail grading, and the Independent Activities Period in January); development of interdisciplinary programs; and growth of cross-registration opportunities with other schools. Overall, alumni who volunteered comment favored these trends in the ratio of two to one. The mixed or negative comments most often reflected a concern that M.I.T. was moving away from its "original" or unique mission and standards; some conveyed a somewhat skeptical "wait and see" attitude. These people see M.I.T. as offering unique and outstanding opportunities which might be diluted if it were to expand its mission much beyond its central strengths in science and technology.

M.I.T.'s role in bringing the resources of science and technology to bear on the problems of society was a theme woven through many interviews. When we asked alumni to talk about what they thought were M.I.T.'s most important missions for the future, two-fifths said M.I.T. should take an active role in addressing such current social problems as energy, pollution, health care, poverty, and those created by technology itself. Some also

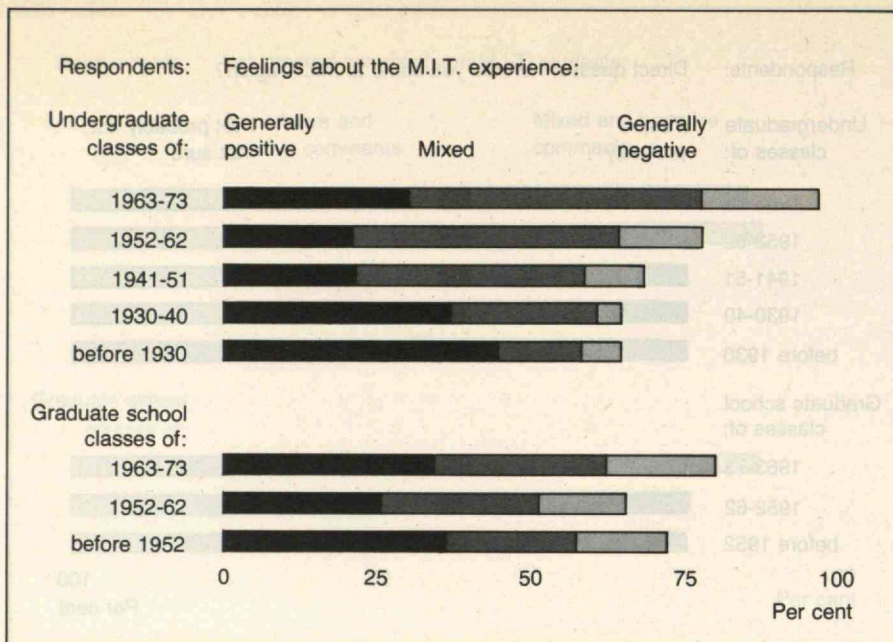
mentioned M.I.T.'s responsibility to impart to students a greater social awareness and accountability. An additional one-eighth of the respondents felt that M.I.T. could best contribute to society through what they regard as the Institute's more traditional role of maintaining leadership in science and technology, of creating new technologies, and of addressing the lack of public understanding of science and technology.

One-fifth of the sample mentioned the divestment of the Draper Laboratory or what they viewed as a curtailment of certain kinds of defense-related work at M.I.T. The majority of those who brought up this subject argued that M.I.T. has developed much of its strength from its relationship with those sectors of society involved in national security and industrial development; in their view, such connections provide the university with important strengths, resources, and responsibilities. On the other side of the issue, some alumni felt that certain kinds of military research are not appropriate missions for a university, or that M.I.T.'s independence might be compromised if it relies too heavily on defense funding, or that today's priorities require a shift to social problems.

The political demonstrations in the late 1960s were mentioned by almost one-quarter of the alumni and by 40 percent of those graduating before 1930. Many who volunteered comment in this area were unhappy that the demonstrations occurred, with a few wondering how this could have happened at M.I.T.; reactions on how M.I.T. handled the situation were mixed.

When we asked about perceptions of M.I.T.'s financial situation, about one-sixth responded that the Institute has a serious financial problem, one-half thought we had some problem, and the remaining one-third were equally divided

M.I.T. is more than a program of classes and laboratory work; it is a host of activities, situations, and relationships which alumni remember as a total experience. How positively do they recount that experience? This chart shows a compilation of respondents' comments volunteered throughout the interviews; it is not surprising that the most recent alumni are more likely to comment on their M.I.T. experiences, and it is interesting that the older alumni mention generally positive recollections more frequently than do their younger colleagues.



between those who thought M.I.T. had no problem and those who had no idea. Direct knowledge of M.I.T.'s financial situation seemed to be very low, with many extrapolating from the general economic climate to estimate M.I.T.'s financial situation. One said, "It's obvious that M.I.T. is getting clobbered by the government and by inflation."

When asked about the importance of alumni support, slightly over one-third of the respondents thought it constituted an important or significant part of the Institute's total financial picture, and another one-third thought it played a small or insignificant part. Undergraduate alumni before 1941 attached higher significance to alumni support than did alumni from more recent classes, who were more likely to see alumni support as small compared with other sources such as government or industry.

The Responsibilities and Bonds Between Alumni and Alma Mater

To summarize alumni attitudes, it is fair to say that there is a solid foundation of positive attitudes toward the Institute. There is a substantial base of good will — though no unanimity of opinion — upon which new kinds of communications and

activities with alumni can be built. One of the strongest messages that comes through in the survey is that alumni are individualistic, and that when they reach back — if they do — to connect with M.I.T., they connect in different ways, at different points in time, and for different reasons.

Graduates do not share a single, common bond to the campus. Not surprisingly, Graduate School alumni tend to think of their association with M.I.T. primarily in terms of their department or research group and less in terms of their Class or living group. Undergraduate alumni, on the other hand, think of their association with M.I.T. as much by living group as by Class, and even more by department. A good many of both graduate and undergraduate alumni think of M.I.T. in terms of specific people or activities. As one alumnus put it: "A place is people to me. When I lose touch with the people, I lose touch with the school."

Some 60 per cent of our sample (representing as many as 30,000 alumni) had visited the campus within the last five years. Their reasons for coming back provide another index of the diversity of alumni ties or interests in M.I.T. "Casual visits" — to see what has been going on since they were here, to show the school to their family or friends, to compare the M.I.T. they visited with the place and the people they knew as students, and, most importantly, to visit old friends — were as common as any reason for returning. These casual visits are intriguing, both because of their large number and because they are in a sense "hidden" from the more formal network of alumni relations. Professionally-related activities — such as professional meetings, consultation or collaboration with faculty, and attending a course or seminar — were another common reason for coming back to the campus.

About four-fifths of the alumni have had some type of contact with M.I.T. since they were students here. For those who were graduate students only, and for the more recent undergraduate alumni (1952 to 1973), the contacts have been predominantly informal, many for professionally-related purposes (for example, correspondence or visits with faculty members). More formally organized alumni activities were cited more frequently by undergraduate alumni who graduated prior to 1952.

Toward More Communication and a Closer Relationship

Based on comments throughout the interviews, only about two-fifths of the respondents indicated more than an incidental knowledge of what has been going on at M.I.T. Nevertheless, more often than not, the people we talked with were generally satisfied with communications from M.I.T. — although many made specific suggestions for improvement or commented on a particular topic on which they would like more information. Those who had a stronger interest in M.I.T. were more likely to make suggestions and criticisms or to indicate a wish for information. In response to a direct question, about one-third explicitly stated that the information they received did not completely meet their needs.

Technology Review, understandably, was a major focus for much of the discussion on communications. About 70 per cent of the sample acknowledged receiving *Technology Review* currently or recently, and most of them said they look at it frequently. Not surprisingly, the people most interested, knowledgeable, and involved in M.I.T. are most likely to receive *Technology Review* and to be its most faithful readers. Of all our respondents who receive the *Review*, about one-sixth read the magazine fairly thoroughly,

"When I came here, I was impressed. When I arrived, I was impressed with myself. Shortly after, I was impressed with everyone else, and worried about myself."

about half read only those sections which are of interest (particularly the feature articles and class notes), and the remaining third tend to glance through it or to look at it only occasionally, if at all.

The many comments made about *Technology Review* covered a broad spectrum. The majority of those who receive the magazine made only positive comments or combined favorable comments with suggestions for improvement. Some alumni made only critical comments, and some offered suggestions without evaluative comment. Overall, about half of those receiving the *Review* made some suggestions regarding ways they felt the magazine could better serve their own needs.

After they commented on *Technology Review*, the respondents were asked if there were any particular information they would like to have from M.I.T. (beyond that provided by the *Review*); and over half mentioned one or more information needs. Allowing for multiple mentions, about one-quarter of the sample stated that they would like more Institute news; a calendar of campus activities was mentioned by about one-fifth of the Boston-area respondents; and about one-quarter of the sample (slightly higher for graduate school alumni) expressed an interest in more information on department- or research-related activities. Almost 5 per cent mentioned an interest in receiving an alumni register, or student or staff directories.

Given the diversity of expectations and needs among alumni in the area of communications, it is difficult to establish a single well-defined measure of how well M.I.T. is doing in this area. But given the substantial levels of interest in M.I.T. and the wishes for more or different kinds of information, there is clearly a potential for further creative effort.

Are there ways in which M.I.T. could have been more helpful to our respondents since they left the Institute? One-fifth of the alumni said yes. Job placement, either from the employee's or employer's viewpoint, was mentioned by 10 per cent — that is, by half of those who felt M.I.T. could have been more helpful. Needs for technical information or continuing education were cited by 7 per cent of the respondents.

Can there be new programs to bring the Institute and its alumni into a closer and more mutually satisfying relationship? To assess this potential for more active partnership, we examined three indicators of alumni involvement — or possible involvement — with M.I.T.: the degree of interest in the Institute, the level of recent activity with M.I.T., and the extent of knowledge about M.I.T. The survey tells us that in our sample there are about 15 per cent who are already closely involved with M.I.T.: These alumni are active, interested and knowledgeable. These people also are more likely to have been the

“M.I.T. did give me something: the self-confidence to know that however hard or seemingly impossible the task, I can do it.”

most vocal in expressing their opinions about M.I.T. in the survey; to be involved in a variety of activities and commitments outside their work and family; to have been on campus within the past five years; to live in the eastern half of the country; to receive *Technology Review*; and to feel that it was very important for them to have attended M.I.T. At the center of this core group are the alumni officers — the men and women who form a nucleus for the Institute's partnership with alumni.

Though it is difficult to characterize the potential for greater involvement beyond this core group, a general estimate supported by the survey data is that about three-fifths of the alumni population, including those already most closely involved, represent a good potential for becoming more closely engaged with the Institute. This overall estimate is supported by a number of indicators of alumni attitude toward M.I.T.: their good will toward the Institute (75 per cent of the sample); their interest in M.I.T. and its activities (60 per cent); their requests for more or different kinds of information and their suggestions on communications (60 per cent); their involvement with the Institute or in alumni programs during the last several years (60 per cent); and their visits to the campus within the last five years (60 per cent).

What about the alumni whose potential for involvement seems to us lower? Among this group are some who have strong negative feelings about M.I.T. or their experiences here. There are others who — either because of attitude or because of present circumstances — feel no real ties to or interest in M.I.T. at present. They may have stronger ties with other schools, they may not have ties with any schools, or they may have young children and may be busy building their careers. Some of these people may see closer involvement with M.I.T. as something to come — in later years. But for the moment their attitude is basically neutral.

To summarize our assessment: There is a core of alumni, about 15 per cent, who are already interested, knowledgeable, and actively connected with M.I.T. Many more beyond that seem to have reasonable potential for more active associations

with M.I.T. We estimate that there are as many as 30,000 alumni (or 60 per cent of the alumni represented by our sample) whose interests and creative energies might find greater resonance with M.I.T. — if the Institute knew how to meet their interests and needs. These needs vary in intensity as well as in kind. To some alumni, greater involvement will come through services M.I.T. might provide to them now or in the future. Other alumni would like more opportunities to be of service to the Institute. Some alumni want both. In any event, it is clear that a closer association with M.I.T. should further the goals of or otherwise provide satisfactions for alumni on their own terms. The survey does not specify how this can be achieved, but it does show that there is a potential to be tapped, and points to some directions to explore.

The issues and questions raised by alumni in the survey present an exciting challenge: how to reach out and open up in ways that will make M.I.T. a more accessible, more vigorous, and stronger institution. Part of what has to be done rests with the Institute; part with the alumni. Most will be accomplished only by working together.

We urge all of you who read this digest of the survey report to join in the discussion of what needs to be done, how, and by whom. We look for your initiatives in listening, sharing, and caring about M.I.T. and about the people who make up our community on campus and beyond.

Constantine B. Simonides is Vice President of the Institute with responsibilities in the areas of organization and information. **Kathryn W. Lombardi** and **David S. Wiley** ('61) are Associates in the Analytical Studies and Planning Group in the Office of the President and the Chancellor. Mr. Simonides had overall responsibility for the planning and development of the survey; the day-to-day direction of the project was assigned to Ms. Lombardi and Dr. Wiley. They were assisted at various times by well over 100 people from the M.I.T. community in the planning, interviewing, coding, and analysis. Douglas Williams of Douglas Williams Associates, Inc., New York, was the principal consultant throughout the project in the design and implementation of the open-ended interview approach. Professor Lotte Bailyn of the Sloan School of Management was the academic advisor for the project. Osgood Nichols of Osgood Nichols Associates, Inc., New York, helped initiate the survey and served as consultant. The project was planned and conducted in close cooperation with Donald P. Severance and the resident staff members of the Alumni Association. Those interested in seeing the full report should write to Constantine B. Simonides, Vice President, Room 3-209, Massachusetts Institute of Technology, Cambridge, Mass., 02139.



For those who remember their student days in Cambridge, only four words are needed to identify this picture: "New England in spring." The photograph is by Calvin Campbell of the M.I.T. News Office.

In This Section

The lights have been turned off, the heat turned down, and in one year M.I.T. has saved \$1 million worth of energy (**page 81**).

"Thoracostomy"? The question was not what it means, but how to spell it; and that was the word that separated the sheep from the winner (**page 84**)...

... in the most publicized event of a month-long "do-your-own-thing" Independent Activities Period (**page 90**).

Like Robert Boyle's ideal gas, student activities will expand to fill any given available volume. What is the optimum density? (**page 86**).

The refrain from du Pont: "We'll work *with* the men; we just don't want to work *under* them!" (**page 88**).

"... loose ... engaging ... candid ... funny ..." If these qualities occasionally let him down in the State House, they assure his success as a teacher at Harvard (**page 92**).

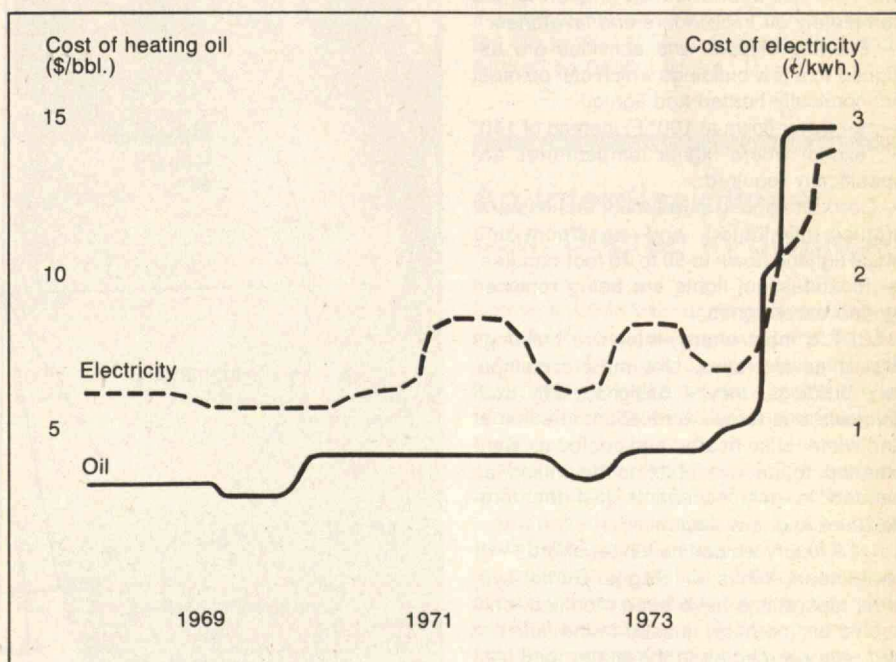
In One Year We've Saved \$1 Million Worth of Energy; and Now Comes the Hard Part

"Drastic changes in the pattern of energy consumption at M.I.T." have resulted from the Department of Physical Plant's program to reduce energy use since first the scarcity and then the increasing price of fuel and power became a central issue beginning in November, 1973. Heat consumption was down 25 per cent and electric consumption down 17 per cent in the year ending in December, 1974, says Carl W. Hagge, II, '57, Environmental Engineer in the Department of Physical Plant.

And energy use during the 1974 air conditioning season was down some 48 per cent from the 1973 record, says Mr. Hagge.

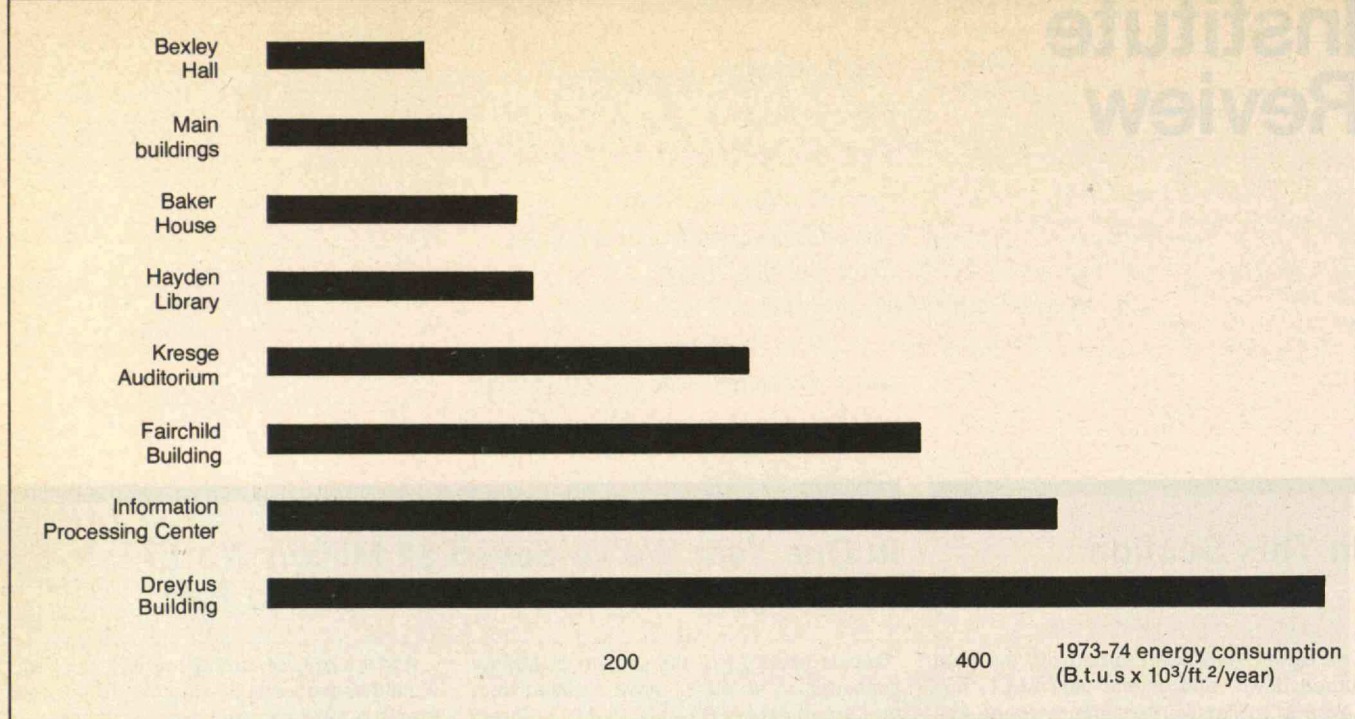
Some of these reductions were the result of individuals' thoughtfulness; lots of people — students and staff alike — went out of their way to turn off lights, close windows and doors, and turn down (or up, depending on the season) their thermostats. But most were the results of changes in ways of operating the physical plant:

— Heating is down to 68° in occupied parts



Without President Gerald Ford's controversial import duty on foreign oil, M.I.T.'s budget for energy — oil, gas, and electricity — is \$5.1 million for the current year; that's up from \$4.1 million in the 1973-74 fiscal year. And the situation would be far worse without the "aggressive energy conservation program" which this year is producing savings approaching 25

per cent of previous consumption, according to Thomas E. Shepherd, Jr., '50, Superintendent of Utilities in the Physical Plant. Mr. Shepherd's preliminary calculations were that the new import duty might raise fuel and energy costs enough to result in a \$200,000 budget overrun in the current fiscal year and require some \$700,000 added to the budget for 1975-76.



Though their windows leak and their space is generous, M.I.T.'s oldest buildings are, in general, the most frugal of energy. By far the glutton is the Dreyfus Building; its modern chemical laboratory hoods require

large quantities of conditioned, fresh air, and recirculation is impossible. But impressive energy savings have been made by the Physical Plant Department during the period covered by this chart:

The peak demand for steam during the winter of 1973-74 was 195,000 lbs./hr., and on a comparable day in 1972-73 the demand would have been 252,000 lbs./hr. That's a solid 23 per cent saving.

of the plant and 50° in unoccupied areas; and heat has been reduced or even turned completely off in corridors and lavatories.

— Evening classes and activities are assigned to a few buildings which can be most economically heated and lighted.

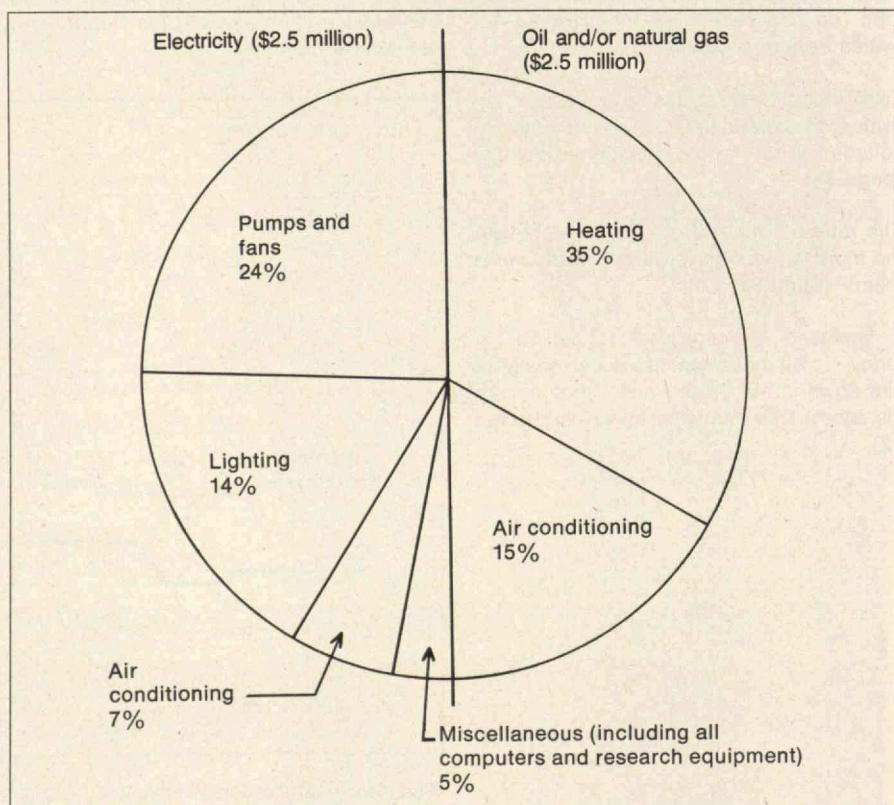
— Hot water flows at 100° F. instead of 140° F., except where higher temperatures are specifically required.

— Corridor lighting is reduced, architectural lighting eliminated, and classroom and office lighting down to 50 to 70 foot-candles. — Incandescent lights are being replaced by fluorescent ones.

M.I.T.'s most energy-intensive buildings are its newest ones. Like most contemporary buildings, they're designed with fixed windows and forced ventilation; in summer and winter alike heated and cooled air were planned to be available, to be mixed as needed to give occupants just the temperature and flow each liked.

... A luxury we can no longer afford — or really need, thinks Mr. Hagge. So the systems' operations have been modified; only cooled air (no heat) is used in the summer and only warmed air in the winter, and less fresh air is introduced to the systems year-around (designs typically call for six to eight changes of air in a building per hour, but two seem to be enough).

Even in summer steam is needed in all M.I.T. buildings, if only to provide hot water; but the steam distribution system, big enough to provide steam heat on winter's coldest days, is hardly efficient in the sum-



How does M.I.T. receive and use its energy? The Institute's \$5 million energy budget is about equally divided between electricity bought from the Cambridge Electric Light Co. and fossil fuels burned in the Institute's own power plant to produce

steam and chilled water. Though we have more computers than any other university (See December, 1974, p. 79), they — and all the rest of the elaborate research equipment — consume but 5 per cent of our energy dollars.

mer: Mr. Hagge thinks more steam may be wasted than is used, and one project now is to map the steam system and close off redundant sections in seasons when they're not needed.

How many more ways can be found to save energy in operations? More than Mr. Hagge can count — though many of the options that remain will involve capital expenditures for new systems and equipment.

Mr. Hagge and his associates are beginning to put into place a concept of computer-controlled monitoring and management of energy distribution — a system which would if fully realized substitute automatic control for the manual intervention which has thus far been used to reduce energy flows at times of low demand. In addition, Mr. Hagge wants to look at heat exchangers for ventilating systems, solar heating, and the possibility of using M.I.T. trash as fuel. If conservation has thus far saved over \$1 million, could we invest some of that in changes from which we'll reap more savings in the future? □

60,000 Alumni Records Go onto Magnetic Tape

The primary records on all 60,000 M.I.T. alumni are now committed to magnetic tape — instead of to handwritten cards; as a result, a small notebook makes available more data than was heretofore shown by a Kardex file 40 ft. long and 2½ ft. high.

The new system provides for continuous updating of all alumni records and for microfiche print-outs of this data on a weekly basis for use throughout the Institute. The same system will be the source of data for a new edition of the *Alumni Register* — the first since 1967 — due out in the fall of 1975. Richard A. Knight, '47, Secretary of the Alumni Association, thinks "M.I.T.'s fiche file will be one of the most comprehensive and accurate in the country. . . . It has already begun to eliminate misplaced documents, clerical errors in transcription, and bulky paper work."

For each alumnus there will be as many as 50 items of information when the file is complete, says Thomas G. Dreyer, Data Processing Manager for the Alumni Association — home address, business position and address, degrees awarded and dates (including those of colleges other than M.I.T.), and alumni giving record. *Technology Review* subscription data are included.

The conversion and continuing systems development work for alumni records is now a major responsibility of a new M.I.T. administrative computer group, Resource/Alumni Data Systems, a cooperative undertaking of the Resource Development and

Alumni Association offices. They will be responsible, for example, for the system through which file data will be converted into typeset copy for the *Alumni Register*.

Alumni who have not yet completed questionnaires for the new file and for the 1975 *Alumni Register* are urged to do so — and those who for whatever reason have not received questionnaires are urged to write Mr. Knight at Room E19-438, M.I.T. □

Graduate Enrollment at a Historic High

Graduate enrollment at M.I.T. in the Fall Term of 1974 was higher than ever before in history — 3,468, compared with a previous high of 3,395 in 1969. The Fall Term figure represented a 3.3 per cent increase over the previous year.

The national trend in graduate school enrollments was the same as M.I.T.'s — up 4.3 per cent over 1973 for an all-time high, ac-

ording to figures of the Council of Graduate Schools in the U.S. But M.I.T.'s growth was bigger than that of the average of private universities.

Enrollment of women in the M.I.T. Graduate School grew spectacularly; 405 — 27 per cent more than in 1973 — were enrolled in the Fall Term of 1974. But Jeanne E. Richard, Assistant Dean of the Graduate School, points out that women — and M.I.T. — still have a long way to go: Women are only 11.7 per cent of the Graduate School population. A more modest increase — 23 per cent — in the number of minority-group graduate students was reported by John Turner, Assistant Dean; the total was 149 in 1974.

Four reasons for M.I.T.'s graduate growth in 1974, according to Irwin W. Sizer, Dean of the Graduate School:

— The number of M.I.T.'s applications was up 7 per cent.

— There was a "modest" increase in industrial and government fellowships for graduate study at M.I.T.

— Demand for scientists and engineers with graduate degrees is sharply up.

— M.I.T.'s Graduate School continues to attract top ratings in national studies of graduate education.

Of the all-time-high Fall-Term Graduate School registrations, 1,620 were in the School of Engineering, 970 in the School of Science, 348 in the Sloan School of Management, 282 in the School of Humanities and Social Science, and 248 in the School of Architecture and Planning. Enrollment gains have been in the Schools of Engineering and of Architecture and Planning and in the life sciences, Dean Richard told Donna Arzt of the *Boston Globe*. □



A new high-reduction storage system for data on 60,000 alumni is now the responsibility of M.I.T.'s Resource/Alumni Data Systems, whose principals include Ms. Merry C. Peterson, Programmer/Analyst; Victor M. Maslov (center), Manager; and Robert F. Matson, Systems Analyst.

An Interdisciplinary S.M. Degree in Science

You've finished your undergraduate degree in science, and you want to spend another year — or perhaps two — preparing for a job in a field which doesn't quite match the interests of any single M.I.T. science department.

Now you can enroll for a Master's degree in Course XXV — Interdisciplinary Science.

Undergraduate degrees in Course XXV have been available since 1971 — following an experimental period in which interdisciplinary science programs were administered within the Department of Earth and Planetary Sciences as Course XII-B. Now the faculty has approved Course XXV's plan for a three-year trial of a Master's-degree program.

Course XXV is supervised by a committee consisting of the Dean of the School of Science, one member from each of the seven science departments, and a representative of the Department of Psychology. The committee accepts undergraduates into the

program, approves each student's program each term, and finally certifies each student for graduation.

Now it will do the same for graduate students who want Master's degrees in programs not available in any department. Such programs may be of great variety — for examples, animal cell science, science education, clinical chemistry, or environmental earth sciences — fields of "applied science that the departments are not doing," Professor Louis N. Howard, Registration Officer for Course XXV, told the faculty as the new program was approved.

There are typically some 20 undergraduates enrolled in Course XXV at any one time, and they follow many and varied programs. An example suggested by Professor Howard is a student interested in all aspects of intelligence — natural and artificial — whose program would involve particularly courses from psychology, electrical engineering, and biology. Such a student might well go on to do graduate work in psychology, thinks Professor Howard. □

Taking the Privacy Act in Stride

More confusion than excitement characterized the M.I.T. community's response as the Family Educational Rights and Privacy Act of 1974 became effective in November.

The Act, familiarly known as the Buckley Act for its author, Senator James L. Buckley of New York, grants students the right to review information held in their college's official files concerning them, in order to insure its accuracy and relevance; and it limits use of that information by others without the subject's express permission. But a host of questions seemed unanswered in the hastily-drafted legislation: What of material obtained under pledges of confidentiality? What of data pertaining to students who happen also to be employees? What about personal files of faculty and staff containing correspondence referring to students? What about information concerning the financial situations of parents of students?

Lamenting the Act's lack of definitions and the absence of federal guidelines for its interpretation, M.I.T. nonetheless made preparations to deal with students' requests to review their files in whatever numbers might appear. Requests would be made in writing; files would be reviewed to eliminate material which did not come within the Institute's interpretation of the law, and within 45 days of their applications students would in fact review the contents.

How many students would ask? How could the potentially immense workload of responding be handled?

Official relief when only a modest number of students sought the privileges it gave them when the Law became effective in

November. No serious discontinuity in operations in the Dean's Office or elsewhere.

In a policy statement, Paul E. Gray, '54, summarized the Institute's posture: "Starting on November 19, all application forms, reference forms, and requests for information about students or prospective students will contain a statement that the information requested may be available for review by that individual. Information about students that is accepted for official use by M.I.T. . . . will be available to the concerned individual for review. . . . But information about individual students will not be transmitted to persons or agencies outside M.I.T., including parents and employers, without the written . . . or . . . the implied consent of the concerned individual . . ."

But Dr. Gray also expressed his sense of the dilemma which many felt: ". . . candid appraisals and evaluations of performance and potential are an essential constituent of the educational process. Further, . . . the provision, with permission, of such information to prospective employers, to other educational institutions, or to other legitimately concerned outside individuals or agencies is necessary and in the interest of the concerned student."

But "these essential educational activities will be conducted in the spirit of the Act," Dr. Gray affirmed.

And to the faculty, Dr. Gray had a short sentence of advice: "Screw up your courage: Write a candid letter about a student and be willing to share it with the student, or else refuse to write a letter at all!" □

Confidential Alumni Records?

What is the status of heretofore-confidential records of alumni giving under the controversial "Buckley Amendment"?

Congressional staff and lawyers who worked on the legislation are quoted in *Chronicle of Higher Education* as saying that "the intent of Congress was not directed at forcing the release of such information to former students.

"The law speaks only of 'educational records' and excludes 'records of institutional, supervisory, and administrative personnel and educational personnel ancillary thereto' . . .," the *Chronicle* notes. □

James D. St. Clair on Watergate

The President can be impeached only for bribery, treason, and *other high crimes and misdemeanors* — and that is where the trouble lies, said James D. St. Clair, former Special Counsel to the President, to a packed luncheon meeting of the M.I.T. Club of Boston this winter.

Did the machinery work? "Yes," he said, "but in a halting, stumbling way . . . but that's the way we humans seem to do things." Some of his thoughts:

The fundamental question was: What is an impeachable offense? There was a serious difference of opinion, and yet in a situation such as this there should be no question of what it takes to impeach — or the President doesn't know where he stands. It should be clearly defined in the Constitution.

The prosecutor wanted information that the President wasn't going to give him. The committee decided that the concept of executive privilege exists, it was just not available in this case. "We lost the battle but won the war."

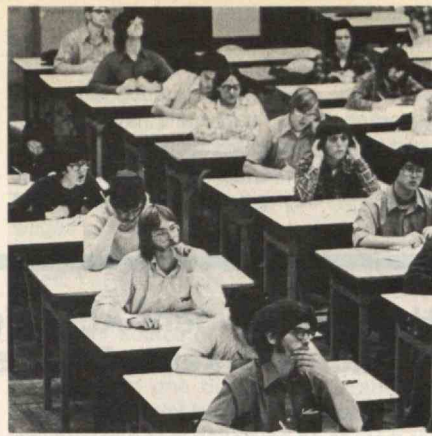
The President's decision to give the committee only edited transcripts was a serious one. That in itself, according to some committee members, is grounds for impeachment. But if so, any dissatisfied Congress could make an unreasonable request, and when refused, start impeachment proceedings. Thus it would become an easy way to get rid of a President — and there should not be an easy way.

As a result of the Watergate affair, power shifted somewhat from the President to Congress. It would be a cause for concern if the pendulum swung too far in that direction; the legislative branch is to propose, not to enforce the laws. "Given human frailty, that we are all blessed with, we must make a sound government structure, and it is important to have three fundamentally equal coordinate branches."

Mr. St. Clair's advice to anyone with respect to tapes: "Don't do it." □

The Spelling Bee: "Mr. Brenner, Please Spell Pogamoggan!"

"Thoracostomy. . . . T-H-O-R-E-C-H-O-S-T-O-M-Y." Beep! For contestant number 45, Jean Hunter, '75, the tone sounded the end of her attempt and a chance for Norman Brenner, a graduate student in Earth and Planetary Sciences, to become the first Institute Spelling Bee Champion. "At that point," Mr. Brenner confessed afterward, "I



Hopes were high during the first Institute Spelling Bee, but as these pictures show, there were occasional doubts in the minds of the contestants during both the preliminary exam (above) and the final round (left). (Photos: Calvin Campbell and Joseph Schuyler.)

felt I had an incision in my chest, just what 'thoracostomy' means." But he did spell it correctly, then spelled the following word, "beriberi," and walked away the winner.

Before the start of the contest — Event #332 in the Independent Activities Period (I.A.P.) calendar — many contestants were evidently nervous, some crocheting to keep their minds and shaky fingers occupied, others juggling their number cards. One hopeful, Alfred Czerwinski, '75, came clad with fake glasses looped around oversized rubber ears, probably the better to hear the pronouncers with.

Cheering sections abounded, and one squad from French/German House (located in Ashdown) encouraged its resident, Jill P. Kern, '78, with, "J-I-double-L, come on, Kern, spell, spell, spell!" Another competitor, Russell Jacoby, '76, unconvincingly remarked that he was not nervous before the competition began; but during the second round, he was "occasionally" overcome after reversing the "s" and the "i."

The Spelling Bee, organized by Harvey M. Elentuck, '74, a New York City Spelling Bee finalist in 1966 and 1967 (Why a spelling bee at M.I.T.? "We were tired of hearing that all we can do is count, compute, and calculate, while 'Harvies' read, write, and spell"), was jointly sponsored by the Dean for Student Affairs Office, Professor Travis Merritt of the Humanities Department, the M.I.T. News Office, Jutta R. Reed, Associate Humanities Librarian, and the Sloan School of Management.

Mr. Elentuck, along with Peter Büttner, '61, and Robert J. Holden, Associate Deans for Student Affairs, served as pronouncers of the words whose spellings were judged by Hartley Rogers, Jr., Associate Provost; Henry Feldman, Research Assistant at the Arteriosclerosis Center and 1960 National Spelling Bee Champion; Mary P. Rowe, Special Assistant to the President and

Chancellor for Women and Work; Barbara J. Trombley, national consultant for Houghton Mifflin Company's *The American Heritage Dictionary of the English Language*; and Robert A. Wake, '74, 1966 National Spelling Bee Champion.

As for prizes, each of the 50 finalists — selected by a written test out of more than 250 aspiring entrants — received a *Dictionary* from Houghton Mifflin and an M.I.T. pin with the compliments of the Alumni Fund. For the winner there was a bagful of prizes: an SR-10 calculator from Texas Instruments, Inc.; \$100 in cash from the Sloan School of Management; \$10 toward travel from Heritage Travel Agency, Cambridge; four pizzas of varying size from Cambridge pizza establishments; and more.

Finishers placing second through 13th did not go away empty-handed either, receiving rewards for their spelling prowess if not for their endurance through this five-and-a-half-hour marathon.

Although the Spelling Bee began easily with — what else? — "easily," several tricky spellings were encountered soon enough — "tweak," "tyrannous," and "tanager;" then came some still more difficult words like "cyan," "flavescent," and "grisaille." Three microphones were on the Kresge stage, and each succeeding speller approached the front of the stage as one finished. Some contenders closed their eyes, some looked at the ceiling to conjure up obscure spellings; some, like Ms. Hunter, "typed" the word in order to bring forth the best spelling.

And how did the victorious Mr. Brenner feel during the early stages of the contest? "Sometime during the beginning, I had the overwhelming urge to misspell a word on purpose just to get out of there," he admits. He had studied for the contest, preparing after the preliminary test given the previous week, by thumbing through his *Oxford Dic-*

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tionary a countless number of times. After that, he read Mawson's *Misused Words* and the *New York Times Everyday Reader's Dictionary of Misunderstood, Misused, Mispronounced Words*; and he had friends read to him from other dictionaries.

Now that the contest is over, Mr. Brenner dreams of making a whirlwind national tour,

emulating Bobby Fischer by taking on five opponents and defeating them in a simultaneous spelling bee; at other times he fantasizes entering a classroom for his thesis defense and hearing his professors say, "Mr. Brenner, please spell 'pogamoggan'." □

Housing Student Activities: The Space Crunch Worsens; Television in a Closet

Most students nowadays know that there is far more to an education than just studying; they can learn cooperation, sportsmanship, crafts, and skills through activities, sports, and hobby clubs — and have fun as well. In a student society that relies far less than it used to on formal dates and dances, activities have a significant social role; no wonder new interests turn up almost every day.

Well and good, except where do all these activities find places to do their things?

A difficult problem is worsening. At its annual meeting late last fall, the Visiting Committee on Student Affairs, chaired by D. Reid Weedon, Jr., '41, found that club offices, storage, and theatrical and musical performances are saturating the available space and facilities in the Student Center, Kresge Auditorium, and elsewhere.

Representatives from many student activities described their space problems to the accompaniment of a slide-show — appropriately titled "The Space Crunch." Most of the exhibits concerned Kresge Auditorium, the Student Center, and Walker Memorial. All of the accumulated information led to a single basic question: "Where are we going to put all of these people, productions, and things?"

Deafened by the Fortissimos

The main wish of the musical and theater groups, especially the Musical Theater Guild and the Symphony, is for a performance center with a well-equipped stage and theater — good acoustics, substantial seating arrangements, versatile lighting — and storage and rehearsal space. The Symphony also wants easy access to its instruments, and its members need rehearsal rooms in which they'll not deafen themselves during every fortissimo.

The best solution, said these students, would be a structure for all the arts that would be large and acoustically right — where Symphony, Band, Choral Society, chamber music groups, pianists, and even drummers could hold rehearsals, meetings, and performances simultaneously without competing for space or attention.

The Student Center — though built just a decade ago — is overpopulated, too. Its two big rooms are in heavy week-end demand, but the Lobdell Dining Room cannot be used until after diners have finished eating (around 7 o'clock) and the tables are

cleared (at least an hour later). After any function the whole procedure has to be reversed for the next day's breakfast, and if the work is done after 11 o'clock it's at overtime pay, an expense charged to the sponsoring activity.

If you hear "angels" singing at night as you walk through the Building 7 Lobby, look again: Some activities find its balconies the most available places for evening rehearsals.

Gold Under the Ice

Athletics have also been hurt by the space crunch. Ice time for hockey practice is a commodity with some of the characteristics of gold. The number of intramural teams is increasing — and so is the "down" time of the rink due to refrigeration equipment failure and warm weather.

The only open space for such outdoor activities as baseball, football, rugby, and soccer is Briggs Field; almost no matter the time or weather, someone or some event is using the Field. Though new lockers for women have been added in the du Pont Athletic Center, a dearth of storage and shower facilities remains to discourage coed athletes.

The solution to all these frustrations is embodied in a new Sports Center now being planned; but its realization may be many moons away.

Walker Memorial, originally the home of most student activities, now houses the gymnasium, Morss Dining Hall, the Muddy Charles pub, Pritchett Lounge, and several activities. The gymnasium and Morss Hall moonlight as examination and function room, respectively; and the space situation is critical for several activities.

And then there are activities scattered elsewhere on the campus. The Model Railroad Society continues in Building 20. MITV, the television news station, stores its equipment (several videotape cameras, film reels, table, and chairs) in a Building 9 closet.

What can be done to ease the space crunch? No easy problem. And no one thinks the Visiting Committee, back late this year for its next annual session, will hear an answer. At the moment it is enough to try "to understand the dynamics of the student environment and the programs which are produced within it," says the prospectus for last fall's meeting. □



A message from Gloria Steinem (here autographing a program for Karen C. Dillon, '78,) after Ms. Steinem's standing-room-only lecture in Kresge Auditorium: "Women's veto power in the bearing of children may be their cartel, their nationalism, their power."

Women and Work: For Feminists, Union Means Professionalism

"What is happening, is that women are finding themselves in the position of working to support themselves. Most opportunities are still secretarial and clerical, and I'm worried that I'll find myself in the same job 20 years from now." This is one woman's reason — an unusual one in the labor movement — for her involvement in an effort now underway at M.I.T. to organize biweekly and "exempt" workers (mostly secretaries, clerks, and administrative assistants).

Many women who work at M.I.T. agree on the need for changes in work policies and in the way their interests are represented at the Institute. But the answers are undergoing a difficult birth. Members of one group of employees feel they have begun to find a solution through A.W.A.R.E., the Association to Work for Active Reform in Employment.

Over a year ago A.W.A.R.E.'s biweekly and exempt employees began to discuss the various sources of dissatisfaction they found with their jobs: low salaries, being locked into job categories with little opportunity for advancement, transfers to more responsible positions in other departments without raises, the need for greater representation and more vacations. They felt frustrated in their attempts to communicate these concerns and proposals to the M.I.T. Personnel Department, so A.W.A.R.E. decided the only way to be taken seriously was to unionize. And after investigating different unions, they decided to affiliate with District

65 of the Distributive Workers of America; now their card-signing drive has begun.

A major outgrowth of becoming "aware" is the discovery of the peculiar situation of Boston clerical workers. A.W.A.R.E. representative Anne Solitto points out that clerical workers, 41 per cent of Boston's work force, take home only 25 per cent of the wages. On the basis of clerical salaries, Boston ranks 13 in a list of 15 major U.S. cities. Yet Boston has the highest cost of living in the nation.

Another source of discontent is the feeling that M.I.T. policies are inconsistent, varying from one department to another. There is no uniform logic for grade and salary levels, say A.W.A.R.E. members; employees are often not informed why they are assigned a particular category. Salary reviews are conducted at the discretion of each supervisor with too little coordination with others, says A.W.A.R.E.

Buzzy Bluestone, a graduate student in the Sloan School, studied this aspect of M.I.T.'s personnel policies under the sponsorship of John M. Wynne, Vice President—Administration and Personnel, last summer. He concluded that both supervisors and employees find the grade structure "a major roadblock" on the road to truly equitable salaries. No matter how well an individual performs, the reward for that performance is constrained by the individual's grade. Further, said Mr. Bluestone, many discussions between supervisor and employee occur "either when the raise was handed out or after the raise was received. In almost all these cases, the idea of performance appraisal was seriously undermined since it was obvious that decisions had been made without any discussion or explanation."

Advocates of the organizing campaign admit that the unionization of clerical and secretarial workers is new terrain for academic employees. The goals transcend increased salaries and benefits, though these are important; the feminist movement is cited for advocating participatory management which would give women and men a collective voice in policies that affect them. Improvements in pay and advancement are relatively simple. The harder problem, admits A.W.A.R.E., is how to confront the basic mode in which decisions are made at the Institute.

No accident that in such an environment Gloria Steinem was invited to speak at M.I.T. in January. Her message: The women's movement is essentially revolutionary in that it seeks to reevaluate the ways we communicate and the structure of our organizations. Solutions cannot be given by any single person but must be worked out organically — keyed to the particular situation — through constant dialogue; even Ms. Steinem rejected her position as a speaker on the podium in favor of the interchange of information on an egalitarian basis.

Women are learning to respect their capacity to work, and with this they have

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gained a new attitude of professionalism. They are asking that policies not be doled out in a paternalistic fashion, that they take part in the decision-making process. "We don't want men to grant us things; we want the power to grant ourselves things."

It is not the light at the end of the tunnel, the utopia that is Ms. Steinem's vision. "Progress is not linear," she said, "it's cyclical — to complete the circle of ourselves." Women must be active in the daily process that controls their lives, and not forget when they achieve traditional "male" positions that the process is incomplete. Basic attitudes toward hierarchy, work and associates must be revised. — *Susanne Fairclough*

Women's Athletics: "You've Come a Long Way, Baby, and . . ."

A few sports announcers still cannot resist the occasional sarcasm about the proper role of engineers when they come to reporting a losing score by M.I.T. in the day's collegiate results. They help perpetuate an idea about "Tech tools" that most people know is a myth; for M.I.T. turns out more men's varsity teams and claims as high a percentage of men's sports (varsity and intramural) participation as any major school in the nation.

If respectability still seems to elude the men, think of the women — relative newcomers to the sports scene and still a minority (15 per cent) of the undergraduates. But women's athletics is a lively reality, and Professor Mary-Lou Sayles, Director of Women's Athletics, told Glenn Brownstein of *The Tech* during the winter that she thinks "the Athletic Department is meeting the needs of women well." There are intercollegiate teams in ten sports (that makes the Institute number two in the country), and five have won varsity status.

The spotlight during the winter season is on basketball, and this year, in its first season as a varsity club, the women's basketball team gave signs of "quickly developing into a major activity at the Institute," thinks Mr. Brownstein. One reason: its audacity in organizing an M.I.T. Women's Invitational

Basketball Tournament, the first running of which brought four teams to Rockwell Cage on January 31 and February 1.

The laurels went to Brown, with Radcliffe second, M.I.T. third, the University of Chicago fourth. But there was national publicity as well as a lot of campus attention, and when the dust settles, athletics for women at M.I.T. may turn out to have been the biggest winner of all.

As of this year, some 200 students are involved in the five women's varsity sports — basketball, crew, fencing, sailing, and tennis; countless more are taking classes and participating in intramural and club sports programs. Only two women are full-time members of the Athletic Department staff — Professor Sayles and Margaret B. Lettvin, whose official title is Lecturer in Charge of the Program in Self-Designed Fitness. Nine coaches — eight of them part-time, two of them women — work with the women's varsity teams. Taking the Athletic Department as a whole, the full-time faculty roster shows 16 men and one woman, Professor Sayles expects another woman will be on the full-time staff by next fall.

Facilities for fast-growing women's sports are a problem, too — especially in a time of financial stringency. New lockers have been installed in the du Pont Athletic Center, but

since the athletic requirement has been extended to undergraduate women there are still too few to meet the need. Until this winter the women's crew (and their visiting opponents) were served by a dozen lockers (toilet, but no showers) in the Pierce Boat-house. Now there is a new, commodious locker room and a trainer available part-time for physical therapy and training.

Travel funds are short, and so most of the women's teams play schedules with Boston-area opponents. In general, thinks Professor Sayles, men's teams — including freshman squads — have more chances to tackle interesting, out-of-town competition than do the women, and more trips for the women would markedly improve team spirit and visibility.

Professor Sayles also sees women becoming more self-confident and learning to govern their own sports more rapidly than most of the M.I.T. community realizes — or perhaps is willing to admit. The basketball tournament is an example.

"No one ever said that the road to acceptability was an easy one," Mr. Brownstein wrote in *The Tech*. But the women are ready: "We'll work with the men," says Professor Sayles. "We just don't want to work under them!" □



Women's sports are coming of age at M.I.T., and to remind the community of that fact the coeds this winter helped organize and stage the first annual Invitational Women's Basketball

Tournament. After a narrow defeat at the hands of Radcliffe (right), the M.I.T. coeds returned to claim the consolation game (above) with the University of Chicago.



The Gallery



Midwinter events (clockwise from the top right):

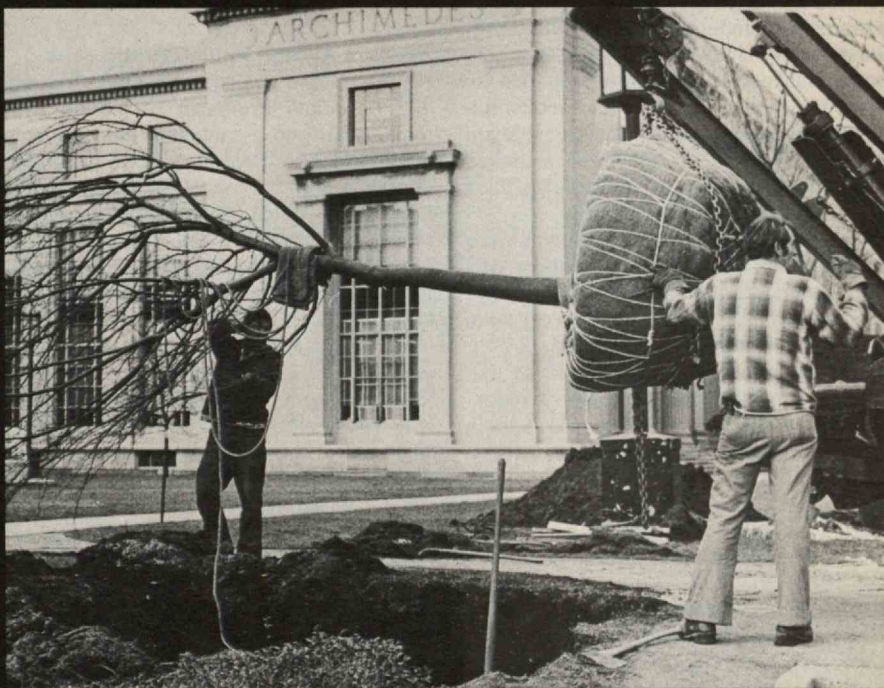
—WNAC discovered two secretaries behind one desk at M.I.T., and Channel 7's Jacqui Adams (center) came out to interview Susan Baram and Naomi Landau (right) in the Freshman Advisory Council office. Ms. Landau works mornings while Ms. Baram watches the children; then their roles are reversed in the afternoons.

—Mild midwinter weather gave yardmen a chance to make headway on spring chores: a blight-resistant Japanese Zelkova tree replaces a Great Court elm which fell victim to Dutch elm disease.

—Members of the Athletic Board spent an evening with M.I.T. sports, watching hockey, basketball, and gymnastics teams in action. (Photo: Owen D. Franken)

—The visitor is Thurman Robertson of the University of Alabama, learning from Martha Pennell (center) of the Planning Office about M.I.T.'s INSITE II space planning system.

—To honor the late William D. Coolidge, '96, Climax Molybdenum Co. struck a series of Wedgwood medallions; and Robert Q. Barr, the company's Director of Technical Information, came to M.I.T. to present one to Natalie Nicholson, Director of Libraries.



I.A.P. 1975: Pollution, Toy Design, Chinese, Philosophy, Economics — Whatever Your Thing, Do It!

For the fourth consecutive year, students and faculty spent January at M.I.T. each doing "his own thing" in a between-terms Independent Activities Period.

It was a chance for faculty to share their research with undergraduates, to talk about questions which never find their way into formal classes and seminars; a chance for students to look into ideas and books, activities and devices to fulfill interests that are frustrated by term-time pressures; a chance for hobbyists to ride their favorite hobbies as lecturers and demonstrators.

More than 500 events and programs were listed in an I.A.P. guide whose purpose was to lure students back to the campus after Christmas holidays; 85 per cent of these were offered through academic departments and laboratories, 15 per cent by students and non-academic groups. A questionnaire of I.A.P. organizers found them enthusiastic: 40 per cent had more participants than they expected, only 20 per cent were disappointed. Perhaps 75 per cent of all M.I.T. students were back on the campus for at least part of the four-week period.

There were lectures — many every day — on a wide range of issues: climate change, x-ray astronomy, petroleum refining, urban dynamics, architecture, law of the sea, energy policy, women in the professions, weather forecasting, waste disposal, earthquake prediction — you name it.

Workshops and laboratories, too — art, glassblowing, welding, toy design, computer simulation, energy conservation, transportation and many more. Experiments, too: One group of students interested in urban noise learned how to measure wheel squeal of M.B.T.A. street cars in Lechmere Square.

For some students I.A.P. meant a chance to make up academic requirements in intensive (full-time) versions of basic subjects in physics, chemistry, and mathematics. But for most it was a chance to explore highways and byways which might otherwise be closed to them by the pressures of the academic term and — thereafter — of professional careers.

The month's biggest attractions were a lecture by Gloria Steinem (see page 87), which packed Kresge Auditorium; a spelling bee (page 84) which kept hundreds at the

Auditorium well beyond midnight; and a lecture on "Nutrition of the Pepsi Generation" by Professor Howard Appledorf, Ph.D. '68, of the University of Florida, which drew an audience of more than 400.

Anchors Aweigh in the Towing Tank

For the second straight year, Clark Graham, '67, Associate Professor of Marine Systems, organized a contest to help students learn "how much power must be expended in driving a ship through the water and the factors which influence the hydrodynamic resistance of a ship." Each student was to build a hull model which he thought would have least resistance at scale speeds of 15 knots, 37 knots, or both 15 and 37 knots.

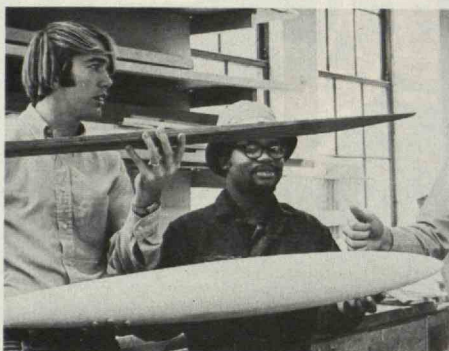
Richard D. Hamly entered the contest last year — and won. He tried again this year, with a long, streamlined, bright red hull which was supposed to beat his last year's white entry. Mr. Hamly — who is a graduate student in naval architecture — was a winner, but the wrong hull (last year's) won, and now he has to solve the riddle of why all his calculations failed to come out right.

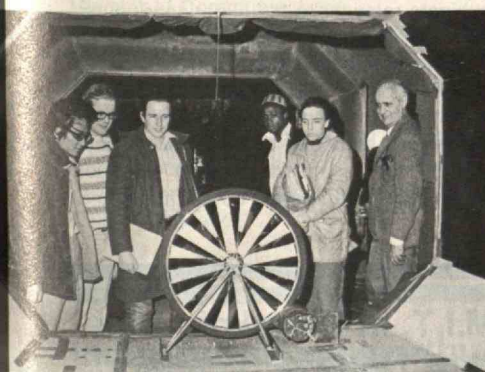
In all, 13 boats were entered, and Professor Graham is pleased — a "worthwhile endeavor," he says, because of the students' enthusiasm and "the number of fairly novel concepts" they came up with.

Cooking, Talking, and Living Chinese

For 17 Wellesley and M.I.T. students, I.A.P. was a four-week experiment in Chinese living.

Concerned that there was no meeting place in Cambridge for Chinese students and others interested in China and Chinese, Henry Sang, Jr. '78, who is studying Chinese at Wellesley through cross-registration, set out to create a "Live-in-China" house for the four weeks of I.A.P. The 17 students (five from M.I.T.) lived in Gray House on the Wellesley campus, studied Chinese, cooked their own Chinese dinners (chopsticks only), and tried all the while to communicate as much as possible in Mandarin Chinese. Everyone was busy on other I.A.P. activities during the day, but the evening meetings were "so interesting that often the group wouldn't break up until midnight," says Mr. Sang. □





during the Independent Activities Period could so different things have happened at M.I.T. in a month. The pictures show (clockwise from the top column): casting metal to recreate ancient bells noted for their resonance, testing an ionized polyester-polyethylene balloon which will create a cloud in a study of atmospheric electricity in the lobby of Building 7, demonstrating a bicycle windmill in a 30 m.p.h. wind, learning the art of repairing a piano, preparing nylon for a dome to be erected over City Hall Plaza as part of a Bicentennial celebration, dancing with the President, preparing models for a towing tank, and building a model-ship-in-a-bottle. Photos: Calvin Campbell, Roger N. Goldstein, '74, and Thomas F. Klimowicz, '77)

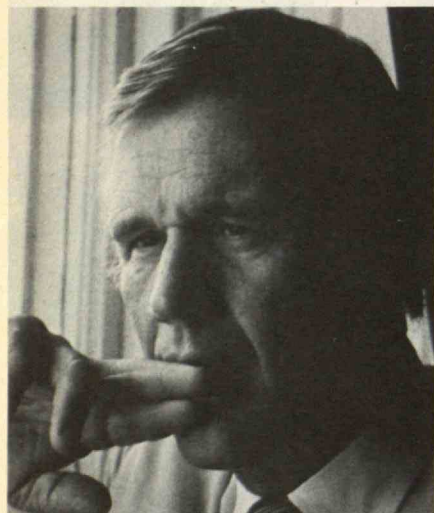


Frank Sargent Looks Back

Francis W. Sargent, '39, has left the State House now. He says he's going to miss, very much, the people, being at the center of the action, making decisions, trying to solve the next crisis.

What of those six years? Here are some of his recollections, as recorded after an interview by Martin Linsky of the *Boston Globe*.

One of the difficult moments — the one that hurt the most — was the firing of former Corrections Commissioner John Boone: "... I could see for weeks that I was going to have to do this. He brought some extraordinary ideas into the state. I was torn. ... The guards [at Walpole] were so against Boone. I just knew there was no way of it coming back together again. ... He became the symbol of frustrations about lawlessness. ..."



The new professor packs them in at his seminar at Harvard. Francis W. Sargent jokes about his new role — he says he destroyed the sign that sat for six years on his State House desk and read: "Don't ask me. I never went to Harvard." (Photo: Ed Fitzgerald from the Boston Globe)

He talks of another emotional, difficult time: "The demonstrations in front of the State House when all the kids came after Kent State. ... I was criticized but I would do exactly the same thing again for several reasons. It did start with a prayer ... 99 per cent of them were genuinely upset. And I decided that their request was a reasonable one — not to take the flag down, but to put it at half-mast in memory of those kids who had been shot. ..."

His actions have been difficult to predict. He made a reputation as a highway builder; later, as a highway stopper. He antagonized groups whose support would have been easiest to claim (business, hard-core Republicans) and won over those who seemed at first out of reach (blacks and women activists). He appointed several of his loudest legislative opponents to the bench and to high positions in the executive branch. He is the public man — genuinely turned on when moving through a crowd, telling jokes, slapping backs; and the introspective fisherman, rowing out alone to sit for hours in his 14-ft. aluminum boat.

His successes, as he sees them: the adoption of the cabinet system, the deinstitutionalization of mental health and corrections systems, the prevention of highway development within Route 128. He feels he did more with the legislature than he is given credit for; the only regret about his campaign is that he didn't do a good job of selling his accomplishments over the past six years. He's proud of the job he did, and very aware that he had a terrific time.

He would like to be remembered as the one who dared to stand up for an awful lot of things; "maverick" is the word he feels most comfortable with. He describes his personal characteristics as flexible, tolerant, instinctive ("I always operate on my gut and my gut has been right most of the time"), and open ("I want to ask everyone what they think"), waiting until the last minute to make up his mind. "Get as much conflicting opinion as you can," he advised his successor, Michael Dukakis, "and hold your own judgement until last. Hold your options open as long as you can." But these remarks are interpreted by his critics as indecisive — and that label has often plagued him.

Laughing is important to him. "I can laugh

any old time. If we make a mistake, I can laugh ... I love it if I can make other people laugh. I think people today are so uptight, so concerned about everything. ... The man his friends know is loose, engaging, candid, funny.

He has tremendous feeling for people. "I'm going to miss the people I've had laughs with and miss the ones I've had arguments with ... I care whether people like me because I usually like them. I don't put on an act. I don't work at it ... He is indignant at fakers and those who hold a grudge. "The ones I respect are the ones who say, 'O.K., I am going to be with you on this thing,' and you don't have to worry. You know that they're going to be there."

On February 1, 1975, Frank Sargent began the spring term as a Fellow at the Institute of Politics of the John F. Kennedy School of Government for one semester. His job will include directing an extracurricular student study group; informally discussing with faculty and students a variety of subjects relevant to his experience; pursuing topics of special interest to him, such as the analysis of policies relating to privacy and freedom of information and to energy and the environment. But local speculation is that — for a man to whom the public aspects of public life has meant so much — an academic career can hardly be permanent. □

M.I.T. in Bangkok: Nine New National Leaders

Adul Pinsuvana, '59, of the American University Alumni Association in Bangkok, describes it as "one of the most successful events that we have ever had" — a dinner of the Association in honor of M.I.T. and nine Institute alumni who occupy positions of major responsibility in the country.

Dr. Paul M. Newberne, Professor of Nutritional Pathology, spoke to some 90 A.U.A.A. members in the Veranda Room of the Oriental Hotel, Bangkok, on November 7. Of the audience at least half were M.I.T. alumni, according to Wimon Wiriyavit, '46, President of the M.I.T. Club of Thailand.



Among guests at a dinner of the American University Alumni Association honoring M.I.T. in Bangkok, Thailand, on November 7: (left to right) Prasong Sukhum, '53; Wimon Wiriyawit, '46, President of the M.I.T. Club of Thailand; Mrs. Wiriyawit;

Sivavong Changkasiri, '58, Secretary of the Club; Chaovana Na Sylvanta, '53; Dr. Paul M. Newberne, Professor of Nutritional Pathology at M.I.T. who was the speaker of the evening; and Adul Pinsuvana, '59, Secretary General of A.U.A.A.

Captain Wiriyawit's recent election to the National Legislative Council of Thailand placed him among the evening's nine guests of honor. The others:

— Krisda Arunvongse, '55, Dean of the Faculty of Architecture at Chula University, Bangkok.

— Sivavong Changkasiri, '58, a new member of the National Legislative Council.

— Vicha Sethabutr, '39, a new member of the National Legislative Council.

— Prasong Sukhum, '53, Deputy Minister of Commerce.

— Harit Sutabutr, '58, Secretary to the Minister of Communications.

— Siddhi Savetsila, '43, Adviser to the Royal Thai Air Force with the rank of Air Marshal, a new member of the National Legislative Council.

— Chaovana Na Sylvanta, '53, Minister of Communications.

Mr. Changkasiri is Secretary of the M.I.T. Club of Thailand. □

Individuals Noteworthy

Kudos: Honors, Awards, Citations

To **Jean L. Lewis**, '40, the National Community Service Award of the New England Friends of the Jewish Theological Seminary of America. . . . Seven Civil Engineers received the Moisseiff Award from the American Society of Civil Engineers for their paper, "Some Structural Problems: Standard Oil of Indiana Building." The five alumni among the authors are **Thomas G. Harmon**, '73; **Robert J. Hansen**, '48; **Robert D. Logcher**, '58; **E. Alfred Picardi**, '44; and **Robert E. Efimba**, '63. . . . The City Club of New York honored **Soichi**

Kawazoe, S.M. '31, and **Olivind Lorentzen, Jr.**, '43, for their contributions toward making New York a "world city."

Counselors:

Officers, Directors, and Advisors

Philip N. James, '54, Director of the University of Southern California's Idyllwild campus . . . **Robert S. Broughton**, S.M. '59, Professor of Agricultural Engineering, McGill University, has been elected President of the Canadian Society of Agricultural Engineering . . . **Clifford J. Kronauer**, '51, General Manager of the Technical and Support Services Department at General Electric's Valley Forge Space Center, appointed to the Board of Directors of the American Defense Preparedness Association . . . **William C. Mercer**, S.M. '56, President and Chief Executive Officer of New England Telephone and Telegraph Co., has been appointed to the Board of Overseers of the Tuck School of Business Administration at Dartmouth College.

Three M.I.T. Professors have been chosen by N.A.S.A. to help provide experiments for two Pioneer-type space probes of the planet Venus: **Gordon H. Pettengill**, '48, Professor of Planetary Physics; **David H. Staelin**, '60, Associate Professor of Electrical Engineering; and **Irwin I. Shapiro**, Professor of Geophysics and Physics.

New Members of the National Academy of Science: **Jerome Gross**, '39, Professor of Medicine at Harvard Medical School; **Pierre Raoul Aigrain**, Henry R. Luce Professor in Environment at M.I.T.; **David Baltimore**, American Cancer Society Professor of Microbiology at M.I.T.; **Ali Javan**, Professor of Physics at M.I.T.; **Hamish N. Munro**, General Foods Professor of Physiological Chemistry at M.I.T.; and **John S. Waugh**, Professor of Physics and Geophysics at M.I.T.

Paul R. Larson, S.M. '54, General Manager of Standard Oil Refinery has been named President of the Pascagoula Rotary Club.

Items of Interest

Three M.I.T. alumni made presentations at a technical session on the theme "Survival — A National Goal for Living Within Our Resources," during the autumn meeting of the National Academy of Engineering. **John G. Linvill**, '43, Professor and Chairman of the Electrical Engineering Department at Stanford University, chaired the session and gave the presentation, "An Outline of Elements of a 20-year Plan." Other M.I.T. alumni participating were **Robert H. Cannon, Jr.**, '50, Chairman, the Division of Engineering and Applied Science, California Institute of Technology: "A Reevaluation of Transportation Needs and Substitutes"; and **W. Kenneth Davis**, '40, Vice President, Bechtel Power Corporation: "Energy Consumption and a Desirable Standard of Living."

Dirk J. Struik, Professor Emeritus of the M.I.T. Department of Mathematics, was honored with a reception and dinner on the occasion of his 80th birthday.

Appointments: Moving Up in Academe

Terry J. Vander Werff, '66, Chief Bioengineer and Head of the Biomedical Engineering Program, Groote Schuur Hospital and the University of Cape Town Medical School, South Africa . . . **Raymond L. Bisp-linghoff**, formerly Professor of Aeronautics and Astronautics and Dean of Engineering at M.I.T. and more recently Deputy Director of the National Science Foundation, Chancellor of the University of Missouri at Rolla . . . **Felix Haas**, '49, formerly Dean of Purdue University School of Science, to the university's Provost . . . **Mortimer M. Labes**, Ph.D. '54, Chairman of the Department of Chemistry, Temple University . . .

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Adrian Melissinos, Ph.D. '54, Chairman of the Department of Physics, University of Rochester ... **Charles M. Antoni**, '37, Chairman of the Department of Civil Engineering, Syracuse University ... **James W. Harrill**, S.M. '64, Director of Aerospace Studies, Syracuse University ... **William L. Hsu**, '67, Professor of Engineering, Swarthmore College ... **George L. Claffen, Jr.**, '69, Professor in the Department of Architecture, College of Engineering, Temple University ... **James W. Triant**, '67, Clinical Instructor of Prosthetic Dentistry, Harvard University School of Dental Medicine ... **Ronald W. Schafer**, Ph.D. '68, the John O. McCarty/Audichron Chair in Digital Engineering of Georgia Tech.

James McCormack, 1911-1975

Major General James McCormack, S.M. '37, who was Special Assistant to the President and later Vice President of M.I.T. from 1955 to 1965, died at his winter home at Hilton Head, N.C., on January 3. He was 64.

After leaving M.I.T., General McCormack was for five years Chairman and Chief Executive Officer of the Communications Satellite Corp., and after retirement from that assignment in 1970 he retained his place on COMSAT's Board of Directors until 1973. Meanwhile, from 1964 to 1965 General McCormack had been the first Chairman of the new Massachusetts Bay Transportation Authority, organized to extend the services previously operated by the Metropolitan Transit Authority.

In his M.I.T. assignment, General McCormack was responsible for supervision and management of the Lincoln and Instrumentation (now Draper) Laboratories and in general for industrial and governmental relations. Earlier, in a military career which began with graduation from the U.S. Military Academy in 1932 and which brought him to M.I.T. for advanced study in civil engineering, General McCormack had been Director of Military Applications at the U.S. Atomic Energy Commission and a staff officer in numerous posts concerned with construction, research and development, transportation, and political-military affairs of the War Department.

There were many tributes from M.I.T. leaders. Howard W. Johnson, Chairman of the Corporation, said that General McCormack's "creative impulse in the cause of national defense, in the whole domain of science and public policy, in university governance, in industry, and in institution-building enriched and enlivened our national life." Julius A. Stratton, '23, President Emeritus, described the range of General McCormack's knowledge as "tremendous, encompassing a profound understanding of education, business and indus-

try, and the structure and operations of government." And James R. Killian, Jr., '26, Honorary Chairman of the Corporation, wrote that "we remember him for his exceptional poise, his attractive personality, and the articulateness with which he applied his qualities of leadership." □

George A. Znamensky, 1891-1975

George A. Znamensky, Assistant Professor of Russian, Emeritus, died in Arlington, Mass., on January 6; he was 84.

Professor Znamensky came to M.I.T. as a part-time instructor in 1942 and joined the faculty four years later; he retired from full-time teaching in 1955 but continued on a part-time basis until 1960.

Born in Russia, Professor Znamensky received most of his education in the U.S.S.R. and was president of a classical junior college there before coming to the U.S. for advanced work in education at Harvard (M.A. 1932). □

Ralph M. Parsons, 1896-1974

Ralph M. Parsons, founder of the world-renowned engineering construction firm which bears his name and an important benefactor of M.I.T., died in San Marino, Calif., on December 20, 1974; he was 78.

It was Mr. Parsons' gift which made possible the extension of M.I.T.'s former Hydrodynamics Laboratory into the Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics in 1970; at the time of his death, Mr. Parsons had been for ten years a member of the Visiting Committee to the Department of Civil Engineering. James R. Killian, Jr., '26, called Mr. Parsons "a great and good friend," and Donald R. F. Harleman, Sc.D. who is Director of the Parsons Laboratory, wrote Mrs. Parsons that its "excellent facilities" have made possible M.I.T.'s significant contributions "to the development of an exciting and challenging field." □

Samuel V. Chamberlain, 1896-1975

Samuel V. Chamberlain, '18, a versatile artist and writer whose photographs and etchings of the New England scene have

appeared in countless books and galleries, died in Marblehead, Mass., on January 10. He was 79.

Mr. Chamberlain's architectural education at M.I.T. influenced all of his later work, though he never practiced architecture as such. He served as an ambulance driver in France during World War I, and he was so attracted to that land that he and Mrs. Chamberlain returned there for more than ten years following the war. Then they came back to U.S., where Mr. Chamberlain launched his career as a photographer.

His artistic reputation is secured especially by his etchings; Robert Taylor, art critic of the *Boston Globe*, describes him as "a consummate copperplate etcher." To watch him work, said Mr. Taylor, "was to observe an act of primal and pure art."

But Mr. Chamberlain's impeccable photographs attracted a far wider audience. His first calendar based on New England scenes (1940) created a new vogue and led to his ownership of Hastings House Publishing Co. In all, he was the author of more than 80 books. □

Deceased

George R. Wadleigh, '97; January 9, 1974; 70 Flower Ave., Hastings-on-Hudson, N.Y.

Walter W. Wells, '99; December 15, 1974; Clarksville Rd., Princeton Jct., N.J.

Nathaniel D. Rand, '00; October 18, 1974; 1218 W. Braddock Rd., Alexandria, Va.

Burton G. Philbrick, '02; December 9, 1974; 68 Dane St., Beverly, Mass.*

Franklin M. Chace, '04; June 4, 1974; Box 73, East Hampton, N.Y.

William B. Spencer, '05; December 4, 1974; 6712 Wessex Ln., Richmond, Va.

George W. Whiting, '05; November 17, 1974; 4210 North Charles St., Baltimore, Md.

Charles W. Fisher, '06; October 1, 1971; P.O. Box 1101, Carmel, Calif.

James B.L. Orme, '06; December 18, 1973; 400 S. Ocean Blvd., Palm Beach, Fla.

Henry B. Thomson, '06; October 28, 1974; 5319 Nakoma, Dallas, Tex.

Martin Herbert Eisenhart, '07; January 7, 1975; 1316 East Ave., Rochester, N.Y.

John E. Johnson, '08; September 17, 1967; P.O. Box 175, Sardis, Miss.*

J. Scott MacNutt, '08; September 23, 1974; 5067 Westminster Pl., St. Louis, Mo.*

Henry C. Colson, '09; November 25, 1974; 1033 St. Paul St., Baltimore, Md.

John D. Hassett, '11; March 14, 1974; 13 Blithewood Ave., Worcester, Mass.

John A. Herlihy, '11; January 7, 1975; 588 Riverside Ave., Medford, Mass.

Frank G. Smith, '11; June 28, 1974; 1434 Punohou St., Honolulu, Hawaii

Arthur G. Eastman, '13; August, 1972; 18 Rollinson Rd., Worcester, Mass.*

Alfred Katz, '13; December 3, 1974; 71 East 77th St., N.Y., N.Y.*

C. Preble Wetherbee, '13; December 14, 1974; 1200 Roberts Ave., Mays Landing, N.J.*

James B. Carson, '15; June 16, 1974; Rancho De Sonoma, Apt. 93, Sonoma, Calif.

Frederick C. Holbrook, '16; October 29, 1974; 19 Terrace St., Brattleboro, Vt.

Edwin E. Aldrin Sr., '17; December 28, 1974; 15 Brandywyne, Brielle, N.J.*

Dudley E. Bell, '17; November 26, 1974; 824 Radcliffe St., Bristol, Penn.

Arthur E. Dowell Jr., '17; July, 1974; 2001 Jefferson Davis Hwy., Arlington, Va.*

David E. Waite, '17; November 20, 1974; Box 205, E. Boothbay, Maine*

Thomas V. Brosnahan, '18; October 29, 1974; 4216 159 St., Flushing, N.Y.

Samuel V. Chamberlain, '18; January 10, 1975; 5 Tucker St., Marblehead, Mass.*

Samuel Fuller, '18; January, 1975; Plymouth, Mass.*

Leslie N. Iredell, '18; October 9, 1969; 6104 River Ter., Tampa, Fla.*

Edward Rogal, '18; April 28, 1974; 19201 Bethany Dr., Irvine, Calif.

Philo S. Shelton, '18; June 5, 1974; 130 Burr St., Fairfield, Conn.*

Raymond S. Smith, '18; October 16, 1974; 135 N. Main St., Freehold, N.J.*

Theodore Dehon, '19; October 13, 1974; Rte. #1, Brevard, N.C.*

Harold H. Bennet, '20; November 12, 1974; 5072 Tennyson St., Denver, Colo.*

Sidney P. Griffin, '20; November 30, 1974; 300 E. Washington Blvd., Lombard, Ill.*

Daniel E. Whelan, '20; November 29, 1974; 15318 De Pauw St., Pacific Palisades, Calif.

H. Dupont Baldwin, '21; September 19, 1974; 23 State Circle, Apt. 2, Annapolis, Md.*

Dwight V. Gregory, '21; June 19, 1974; 140 Barren Rd., Newton Square, Penn.*

Ralph C. Geckler, '22; April, 1972; 2222 Maya Palm Dr. W., Boca Raton, Fla.*

Herbert A. Hickey, '22; December 6, 1974; 4234 Dutchess Dr., Portage, Miss.*

Andrew Spanur Jr., '22; December 1, 1974; 615 Park Ave., Long Beach, Calif.*

Lewis P. Tabor, '22; October 28, 1974; 523 Righters Mill Rd., Narberth, Penn.*

Joseph H. Cox, '23; February 25, 1974; 630 Milverton Rd., Los Altos, Calif.

Monroe E. Epstein, '23; November 23, 1973; 1000 Leslie Blvd., Jefferson City, Mo.

Roderick B. Jones, '23; March 25, 1974; 640 Main St., Winsted, Conn.

Arne Lier, '23; January 1, 1975; 89 Pine St., Millburn, N.J.

G. Wilbur Seymour, '23; February 21, 1974; 7501 Democracy Blvd., #414, Bethesda, Md.

David W. Skinner, '23; November 16, 1974; 448 Quinoluquin Rd., Waban, Mass.

Gilbert Whitehead, '23; February 27, 1974; P.O. Box 442, Prescott, Ariz.

Hallock S. Dupont, '24; October 3, 1974; P.O. Box 790, Wilmington, Del.*

Vennard Wilson, '24; June 20, 1974; 1780

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Bay Laurel Dr., Menlo Park, Calif.*
 R. Kirk Askew, '25; March 30, 1974; R.D. #1, E. Greenville, Penn.*
 Hugh M. Henry, '25; November 7, 1974; 155 Hilltop Pl., Altamonte Springs, Fla.*
 Henry M. Lyons, '25; August 16, 1974; Woodland Rd., Sunapee, N.H.
 Edward N. Dingley Jr., '26; January 4, 1975; 11165 4th St. E., St. Petersburg, Fla.*
 Emerson W. Eddy, '26; November 25, 1974; 326 Skylock Ct., Dunedin, Fla.*
 Samuel McMurtrie, '26; December 20, 1974; 379 Dexter St., Denver, Colo.
 Clair E. Turner, '26; November 27, 1974; 19 Village Ln., Arlington, Mass.
 Ole F. Christiansen, '27; July 26, 1974; Box 5046, Englewood, Fla.*
 John A. Keary, '27; April 6, 1974; Pleasant St., South Yarmouth, Mass.
 Rene E. Paine, '27; September 1, 1974; 3050 N.E. 42nd St., Fort Lauderdale, Fla.*
 Harold K. Gold, '28; June 2, 1970; 21 Jefferson Rd., Winchester, Mass.
 Harold T. Gerry, '29; September 24, 1974; 1828 Varina Ave., Petersburg, Fla.
 Nerses Der Marderosian, '29; December 7, 1974; 315 Hunnewell St., Needham Heights, Mass.*
 John B. Osborn, '29; January, 1975; 112 Mill Rd., North Hampton, N.H.*
 Gertrude E. Haynes, '30; November 8, 1974; 440 North St., Pittsfield, Mass.
 Norwood D. Kenney, '30; October 22, 1974; 16 Lantern Ln., Hingham, Mass.*

Jules A. Larrivee, '30; September 27, 1974
 Marshall E. Andelman, '31; January 2, 1975; 79 Betts Rd., Belmont, Mass.
 Lawrence F. Brown, '33; June 10, 1974; 67 Indian Head Rd., Framingham, Mass.
 Charles P. Woods, '33; October 18, 1974; 2627 Beecham Dr., Cincinnati, Ohio*
 Reuben M. Haines, '34; December 19, 1974; 21 Bertwell Rd., Lexington, Mass.*
 Joseph M. Colby, '35; October 18, 1974; 4100 Galt Ocean Dr., Fort Lauderdale, Fla.*
 George O. Hutchins, '35; May 21, 1974; 17 Maple St., Braintree, Mass.*
 Joseph W. Epplly Jr., '36; June 1, 1974; R.F.D.#2, Lamprey Rd., Kingston, N.H.*
 John R. Graham, '36; August 8, 1974; 2245 Irvine Ave., Newport Beach, Calif.*
 Wyan Lou, '37; November 10, 1972
 James J. McCormack, '37; January 3, 1975; 1000 Wilson Blvd., Arlington, Va.
 Jay P. AuWerter, '38; December 3, 1974; 23276 Laureldale Rd., Shaker Heights, Ohio*
 Albert R. Kaufmann, '38; June 7, 1974; P.O. Box 105, Waldoboro, Maine
 James F. Benson, '38; December 22, 1974; 75 Alphonsus St., Roxbury, Mass.
 John B. Titherington, '40; November 25, 1974; Flying Bull Farm, Union, Maine*
 Julius Friedman, '41; February 19, 1974; 171 Riverside Dr., Winnetka, Ill.
 C. Richard Ricker, '42; April 29, 1974; 7804 California Ave., Whittier, Calif.
 Paul L. Geiringer, '44; January 10, 1973;

Wild Oaks Village #F, Golden Bridge, N.Y.
 Roderick L. Harris, '44; July 11, 1974; 48 Heather Dr., Menlo Park, Calif.
 James R. Atherton, '47; September 28, 1974; 13509 Mercier, Wyandotte, Miss.
 Lawrence V. Mowell, '49; May 5, 1973; Box 26, Old Mystic, Conn.
 Benjamin Davidson, '51; December 20, 1968; 2802 Webb Ave., Bronx, N.Y.
 Patrick E. Griffin, '51; December 2, 1974; Box 4197, Ponce, P.R.
 James C. Hiester, '51; November 20, 1974; 6708 Dogwood Rd., Baltimore, Md.
 Charles F. Fletcher, '52; September 18, 1973; 24 Symmes Rd., Winchester, Mass.
 James M. Chorak, '57; November 28, 1974; 105 Sala 1312, Rio de Janeiro, Brazil*
 Edward J. Keating, '58; April 22, 1974; 62 Oakdale Way, San Rafael, Calif.
 Robert D. Drew, '64; November 1, 1974; 31 Kingdom Ridge Rd., Wilton, Conn.
 John D. Bannister, '65; December 7, 1974; 55 Bellevue Ave., Summit, N.J.
 Gilbert C. Cooper, '68; October 9, 1974; 835 Avalon Way, Livermore, Calif.
 Martin S. Hoffman, '68; October, 1974; 11 Leseur Rd., Hyde Park, Mass.
 Walter L. Walker, '72; December 29, 1973; 516 Country Club Terr., Midwest City, Okla.*
 Gary G. Caldwell, '74; November 29, 1974; Micajah Hts., R.F.D.#3, Plymouth, Mass.
 *Further information in *Class Review*

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Class Review

96

It is with regret that the class of '96 reports the death of Dr. **William D. Coolidge**, who died at his home in Schenectady, N.Y., on February 3, at the age of 101. A full story of his work will be in the May Review.

A new book on his contributions to society entitled *William David Coolidge - A Centenarian and His Work* is a 100-page volume outlining his life and achievements. The book, published by John Wiley and Sons, New York, was written by Dr. Herman A. Liebhafsky, a longtime colleague of Dr. Coolidge at the G.E. Research Laboratory and emeritus professor of chemistry at Texas A & M University.

At the celebration, Dr. Arthur M. Bueche, G.E. vice president for research and development, noted that it is rare for one individual to make two major contributions to the quality of life as did Dr. Coolidge in the invention of the modern X-Ray tube and the discovery of the ductile tungsten filament. Among his other contributions is included a rich philosophy on man's quest for knowledge. Dr. Coolidge once stated: "Trained minds, firm character, and dauntless courage will be needed to wrestle with the problems of the future, to master their threatening dangers, and to force from them the beginnings of a better, more peaceful, and richer world. There has never been a danger to an individual or nation in knowing too much. The danger always comes from knowing too little." — **Clare Driscoll**, Acting Secretary, St. Joseph H.S. Box 517, Fredriksted, St. Croix, U.S.V.I. 00840

02

Retired chemical firm executive **Burton G. Philbrick**, formerly of Salem, died on December 8, 1974 in the Salem Hospital. He was 93. From the *Boston Herald American*: "Mr. Philbrick was founder and retired partner and executive vice president of Skinner and Sherman, consultant chemists, chemical engineers and bacteriologists. The firm, now incorporated, moved since his retirement in 1952 from Boston to Newton.

"He was one of the small group of scientists who played essential roles in transforming food sales methods from sugar in bins, crackers in barrels and vegetables in season to packaged sugar, boxed crackers and vegetables available year round.

"He became probably the first scientist to

be employed full time by a dairy firm in New England. In consequence, he was granted the third butterfat testing license issued by the state of Massachusetts. It permitted him to certify that the butterfat content stated on a label was correct.

"Years later, after he became a business partner of Dr. Samuel Cate Prescott, for whom the biology building at M.I.T. is named, Philbrick compiled a scientific basis for and wrote the Massachusetts chloridation code, the technological backbone of the state's clam digging industry.

"Still later, he was employed by Clarence Birdseye, a pioneer in the frozen food industry, to perfect and test the effectiveness of processes used to freeze peas, carrots and other foodstuffs.

"When dairy product distributors began to consider a possibility of selling milk and cream in cartons instead of bottles, he was a leader in research that was done to assure public health authorities and customers that the change would in no way diminish the purity and quality of the products.

"He was the founder and member of the Institution of Food Technology, a member of the American Society for Microbiology, American Chemical Society, American Institute of Chemical Engineers and the American Society of Civil Engineers.

"He leaves two sons, Burton S. of Beverly and Richard B. of Chicago; two grandsons, and a sister, Mrs. Gertrude Horsch of Woodbury, N. J." — M.L.

03

A letter from **Andrey A. Potter**: "On page 117 of the December issue of the *Review* there appeared a story about the Purdue Research Engineering Center which is named for me. . . . My first name is Andrey (same as Andrew except where I was born in the Baltic Province of Russia, they did not spell right). At the end of the second paragraph it states "The Andrey A Potter Building will house classrooms and laboratories for electrical engineering and electrical technology." This is an entirely different building which was named the A. A. Potter Laboratories building located in the Calumet Center of Purdue University in Hammond, Ind. The building which is pictured in the December issue is the Purdue Engineering Research Center which was also named for me. The A. A. Potter building which houses classrooms and laboratories for electrical engineering and electrical technology was dedicated in January

1973." (The *Review* would like to apologize to Mr. Potter for our error.)

A New Year's resolution for each remaining classmate to grasp a pen and inform your patient secretary that you are alive and avoid my closing our class news column in the *Review*. — **John J. A. Nolan**, Secretary, Treasurer, 13 Linden Ave., Somerville, Mass. 02143

04

Franklin Chase died at the age of 93 after a long illness in London on June 4, 1974. No details. The son of **Louis Asbury** writes that the whole family was pleased to receive a birthday greeting on the occasion of his latest birthday at the Wesley Nursing Center in Charlotte, N.C. — **Eugene H. Russell, Jr.**, Secretary, 82 Stevens Road, Needham, Mass 02192

05

Every morning for the last two weeks, I have remained at the breakfast table sorting out an accumulation of the '05 doings for the last several months. At the end of 15 minutes, I was so exhausted that I had to go back to bed. These notes are being written under the above explanation with the hope that before next month's deadline comes around that I will be able to continue the sorting and give you a story or two which you have missed because of my sickness.

Now we are 18. The last time I wrote about the statistic, there were 28. In the thought that I have missed out on a report of some of our deceased, this difference of eleven, maybe because I have not reported the deaths of **Balkam, Wells, Polle, Whitling, Graham, Buell, Seaver, Shaw**. — I usually send class condolences to the widows in each case and perhaps have been remiss in some instances.

Right now Katherine and **Harry Kendall** are at their home in Hawaii "for several months." Apparently both are in good condition to enjoy this beautiful life.

Bill Spaulding announces with great gusto the arrival of his first great grandson. Nice work, Bill. At 92 years and with 13 grandchildren I cannot even brag about the prospect of a great grandchild.

Isabelle Prentiss reports that **George** is confined to the second floor and a walker but has perfect care from two nurses and "me for the night care. He has ulcers on his ankles, which keep him tied down and he

cannot get up or down by himself. I am too small to lift him."

Our oldest classmate, **Herb Bailey** of Ontario, Calif. (born September 2, 1880) and one of my very best correspondents, writes very interestingly about his family, most of whom seem to be in professorships in European colleges. To give you the full family tree would involve too much space but why not write him — **Herbert S. Bailey**, 1122 North Euclid Ave., Ontario, Calif. 91762. About himself he writes, "I find that if I get up without taking a few preliminary bending of my legs I sometimes stumble and fall. Then I have to crawl to a chair or table and pull myself up with my arms. So I sit or lie down most of my waking hours."

I suppose I should thank **Gilbert Tower** for preventing us from scoring zero in our last issue. It was a good thought and perhaps it will help him in getting together with **Herman Elsele** to whom he writes in every letter to me. . . . **Bill Ball** is assistant secretary now although my wife Ruth deserves that title because of the unlimited amount of time she has spent helping during my sicknesses.

Despite the fact that I have ahead of me recent correspondence and many Christmas cards, which I would like to acknowledge at this sitting, I am going back to bed and will try to catch up in the next issue. To explain — I was discharged from the hospital on December 7 as cured of my heart problem. However, the doctor's admonition "that you will have to take it easy for a long time," means patience, patience, patience. I think I have done pretty well on previous occasions but still insist that I am a very lucky guy. — **Fred W. Goldthwait**, Secretary, Box 231, Center Sandwich, N.H. 03227

It is with regret that we report the death of **Fred W. Goldthwait** on February 11. In 69 years since his graduation, Fred attended every alumni day but one. There will be more about his life in the May *Review*.

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We are all getting along in life, any news is good; about you, your family, hobbies, or travels. Please send it in, so we will have some notes that will interest the remaining '35 class grads (average age 89).

Our oldest graduate **Harry P. Sweeney** (91), a mining-engineer of Rockland, Maine, gave a very interesting report of his work in the December 1970 *Review*. A rolling stone, but oh what memories.

We are sorry to report the death of **J. Scott MacNutt** (89) on September 23, 1974. He graduated from Harvard with honors in 1906, then M.I.T. when he obtained a degree in biology and public health. After his service in World War I, he made a radical change in his profession from engineering to portrait art. This change was reported in the October/November *Review* of 1970. He has followed his new profession for the past 50 years becoming the leading St. Louis portrait artist.

Another death that occurred some time ago was that of **John E. Johnson**, P.O. Box 175, Sardis, Miss., on September 17, 1967.

We have three changes of address to report: **W. Fred Dolke**, El Rancho Village, 15 Rancho Circle, Bradenton, Fla. 33507; **William H. Medlicott**, Cushing Hospital, Dudley St., Framingham, Mass. 01701; and **Harry F. Richardson**, 170-C Rossmor,

Jamesbury, N.J. 08831. — **Joseph W. Wattles**, Secretary, 26 Bullard Rd., Weston, Mass. 02193.

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Prospects for 65th reunion. Our energetic and dependable permanent reunion chairman, **John B. Babcock, 3rd**, has recently informed your acting assistant secretary and vice president, **Ralph W. Horne**, that he (**Jack Babcock**) has summarized the results of a recent survey which he conducted to indicate which members of our 1910 Class might hope to attend a 65th 1910 Class Reunion if one were to be arranged for 1975 in conjunction with the regular M.I.T. Alumni Day. The Alumni Day is planned for Thursday, June 5, and Friday, June 6. After carefully analyzing the results of his survey, Jack took a long hard look into his crystal ball and tentatively concluded that a 65th 1910 Class Reunion might draw a total attendance of about 13 people, depending on whether each of us retains his present health status. Jack is quite certain that his survey of prospective attendance included a contact with every living 1910 classmate who attended any of our previous 50th, 55th, or 60th reunions. If any 1910 classmate has not heard from Jack and wishes to receive detailed information later regarding a 65th Reunion, he should promptly communicate with John B. Babcock, 3rd, Chairman of 1910 Class M.I.T. Reunion Committee at his residence, 33 Richardson St., Portland, Maine 04103.

More detailed information regarding a 65th Reunion will be sent to all classmates who have indicated an interest in attending. Ample time will be allowed for each classmate to finalize arrangements if he decides to attend. In working up the prospective attendance data regarding a reunion it is believed that all those who are still living have been contacted by mail or phone. In addition to those who appear to be interested in attending a reunion there are about 12 others who would like to attend but feel that their physical condition makes it inadvisable to attempt it.

Since the last previous publication of 1910 class notes in *Technology Review* several classmates have passed away.

George Edward Goodspeed died August 15, 1974, at the age of 87. Following his graduation from M.I.T. he taught for several years at an institution which was then known as Oregon Agricultural College. In 1919 he became associated with the Department of Geology at the University of Washington, and was head of that department from 1936 until 1952. He retired in 1957 from the University of Washington and was named professor-emeritus; he also was designated Honorary Curator of Petrology at the Thomas Burke Museum. Prof. Goodspeed was past president of the American Mineralogical Society. He also was a member of the University Kiwanis Club, the Seattle Rifle and Pistol Club, and Christ Episcopal Church. In his memory the George Edward Goodspeed Geological Scholarship Fund was established at the University of Washington. A daughter, Penelope M. Poor of Seattle, survives. The sympathy of his 1910 classmates is extended to Professor Goodspeed's daughter.

According to the M.I.T. Alumni Records, several other 1910 classmates have passed

away who were not previously reported in 1910 class notes, as follows: **James R. Stevenson**, January 7, 1971; **Leander A. Dow**, May 16, 1973; **Roger F. Hill**, September 18, 1973; **Walter S. Davis**, September, 1973; **Richard R. Taylor**, April 2, 1974.

Please send Class Notes items to **Ralph W. Horne**, Acting Assistant Secretary, c/o Fay, Spofford & Thorndike, Inc., One Beacon Street, Boston, Mass. 02108

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Franklyn Stibbs has been in a convalescent home since July. . . . A note from **D. P. Gaillard** says he was an investment manager, now retired; also colonel, retired, U.S. Army. — M.L.

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So far, in the last of January, we have had a good winter about Philadelphia. Our first snow storm of two or three inches came this week and there have been very few days when the temperature was below freezing. It is regrettable that news contributions received for this issue are almost nil, but here goes. **Harold Mitchell**, one of our best correspondents, writes that he and Mildred are now in good shape so far as they can expect. Harold is still active in the conservation of wild life, mostly birds, as well as in the preservation of natural areas. . . . **Jim Cook**, who lives alone in Marblehead, Mass., unfortunately broke his right leg last October, necessitating three weeks in traction. This is his second broken leg in a few years! He wrote that he hoped to be discharged from the hospital just before Christmas, and if so, planned to spend Christmas with his two daughters and their families. You have been getting more than your share, Jim. We hope all is progressing well.

I regret to report the passing of **Frank Caldwell**, West Hartford Conn., on December 23, 1974. Frank was well known for his pioneer work in the development of the controllable pitch air plane propeller, which permitted the full use of power during take-off and climb. It was universally adopted and is still in use about the world, where propeller planes are in use. At Tech Frank helped to form an Aero Club and built gliders which interested him so much that on graduation he joined the Curtis Aeroplane Co., Hartford, Conn. When the war started, he joined the U.S. Signal Corp. in Dayton, Ohio and became chief of the propeller branch where he more fully developed his propeller. In 1928 he went with the United Aircraft Co. in Hartford where he completed the development of the controlled pitch propeller. In 1940 he became their director of research and helped to develop their research laboratories. Here he was employed until his retirement in 1955. Back in 1933 he was presented with the Collier Trophy, a top international aviation award. A few years ago he wrote me that he was enjoying his retirement more than his job, what with his golf and reading extensively. Frank is survived by his wife, Marjorie, and a son Walter to whom we have sent our sympathy and that of the class. — **Ray E. Wilson**, Secretary, 304 Park Ave., Swarthmore, Penn. 19081

Well! The holidays have come and gone. We spent Thanksgiving and a few days following with Roz's family in Portsmouth, Rhode Island. Over the holidays many of our summer neighbors returned for vacations and visits. Our older daughter Janet and her husband, Raymond Ruder have purchased a condominium in Falmouth, Maine and shortly are moving from Nashua, N.H. We have been in typical good health except your secretary has been somewhat hindered due to a sprained left ankle and a sprained right ankle with gout and arthritis thrown in for good measure. Most of these ailments have subsided and now I can navigate with the help of a cane.

We have been fortunate in receiving notes and Christmas cards from some of our classmates. **Ken Blake** wrote: "Glad you mentioned 'Bird' Duff, '14, in the Oct./Nov. class notes. Hadn't thought of him since the end of World War I when we were together in the Chemical Warfare Service." ... **Eugene McDonald** is planning to attend the 65th reunion and says, "We certainly enjoyed the 60th at which you took beautiful care of us". ... **Raymond B. Haynes** writes, "I have remained active and go almost every day to my office at Wellington and Co., 120 Broadway, New York. We are living in such an interesting and rather exciting time that it is desirable to keep in close touch with the investment markets. I am sorry that I have not been able to join in any of the class reunions since our 50th at Oyster Harbor in 1963 which was very pleasant indeed. Please give my regards to any of our classmates whom you may see." ... **Leon W. Parsons** wrote that he and his wife are well and "have added a new great grandchild to our family." I hope Polly and you, Lee, have returned to your usual good health.

Also, season's greetings were received from **Earle Lincoln**, Maurine and **Allen Brewer**, Della and **David Stern**, Janet (Mattson) and Frank Pillman; Mrs. **Prescott** (Marguerite) **Kelly**, and Mrs. **William** (Josephine) **Mattson**. We were especially pleased to receive a group picture of the Ellen and **Ellis Brewsters** taken on Ellen's 80th birthday.

The following deaths of a number of our classmates have been reported and notes of sympathy have been sent to the families of **Alfred H. Parthum**, CH, August 2, 1974; **John F. Foley**, EE, November 17, 1974; **Arthur G. Eastman**, ME, August, 1972; **C. Preble Wetherbee**, EE, December 14, 1974; and **Alfred Katz**, CE, December 3, 1974. A letter from Emma Strock, C. Preble Wetherbee's sister-in-law, said, "He was recovering in a convalescent center in N.J. from a fractured hip, when he had a sudden attack of pulmonary embolism and died in a few hours." Mrs. Alfred Katz gave a short history of her husband. Before Fred's retirement he was vice president of Colloids, Inc., Newark, N.J., dealing in textile chemicals. Afterwards he did volunteer work to help find employment for workers in the industry who were displaced by mergers, etc. They were married May 23, 1954, and had a stepson from a previous marriage, three stepdaughters, seven grandchildren, and seven great grandchildren.

Keep healthy and write your secretary of your future plans and present activities.



Ms. Luscomb today

At 87, She's Still a Campaigner

An 87-year-old M.I.T. alumna, Florence Luscomb, has had difficulty finding a commune to join in recent years.

"After our last commune broke up last year, I tried to find another, but some had no openings and others would not take anyone over 35," she explains.

Small wonder, then, that Ms. Luscomb, '09, long a fighter for public causes, is co-sponsoring legislation to help "legitimize" communal living in Massachusetts. The bill she is sponsoring, introduced in the Massachusetts legislature by State Senator William Owens of Boston, proposes that communes be considered "family units" instead of "lodging houses" for zoning purposes and thus legal in residential zones.

Ms. Luscomb, who still maintains a rigorous speaking schedule, appeared at M.I.T. this winter, speaking on "Women Architects and Their Work" for the Sexual Politics and Design lecture series offered by the School of Architecture.

Ms. Luscomb now rents the partially-heated top floor of an old house in Brookline, but she has lived in various cooperative groups for more than 25 years. She has always been the oldest member of the groups, usually comprised of graduate students, but this has never bothered Florence, who is young at heart.

For Ms. Luscomb, who has no living relations, communal living offered a satisfying lifestyle for many years. "I tried living by myself," she recalls, "but it was inhuman. I'd come home to a dark house and there'd be no one to share ideas with when I was home."

Florence Luscomb has miraculously managed to preserve the same interest in social and political reform that she had when she stood on soap boxes and spoke out for women's right to vote more than 60 years ago.

When Florence came to M.I.T. in 1905, there were only 12 women students at the Institute. The women's suf-

frage movement was gaining momentum and Florence organized small "parlor meetings" with other M.I.T. women. Ellen Swallow Richards, M.I.T.'s first woman student, was an instructor then and would meet with women students as an unofficial dean of women, Ms. Luscomb recalls. Nor did M.I.T. have women's housing facilities in those days. To attend classes, Florence had to walk six miles a day.

But, the opportunity to study architecture at M.I.T. was an exciting proposition for a woman in 1905 and Ms. Luscomb remembers her first year "was one of the happiest" in her life.

After graduation in 1909, Ms. Luscomb went to work for one of the few employers who would hire a woman in 1909 — another woman — Ida Annah Ryan, '05, an outstanding architect. The two eventually went into partnership and worked together until World War I halted all building.

At that time, Ms. Luscomb, already immersed in the suffrage movement, began devoting herself to full-time social and political reform. She became executive secretary of the Boston Equal Suffrage Association for Good Government. She later became the president of The College Equal Suffrage League of Massachusetts and assistant executive secretary of the Massachusetts Civic League. She was involved in pressing for more humane conditions in garment "sweat shops," aided in union organizing and even ran for governor of Massachusetts in 1952 on the Progressive Party ticket on the platform of "feminism, socialism and the peace movement."

She spent many hours over the past 65 years on the picket lines, soap boxes and street corners campaigning for labor movements, equal rights, peace movements and women's rights. Yet, with all her numerous accomplishments behind her, Florence Luscomb prefers to remain in the mainstream of social action, battling away — this time for communes. — *Ellen Hoffman*.

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Alden Waitt and some of the rest of us feel that we might best observe the Bicentennial by having a reunion in 1976. He would be glad to hear from any classmates who might like to give him their ideas.

Writing to Alden last November, **Frank Atwood** recalled that he first met **Harold Richmond** when they were taking the entrance exams, and that Harold lent him an algebra book to help him with problems he hadn't had in high school. Frank mentioned also the memorable trip we took in a submarine at New London during one of our reunions. Harold and Alden were on the conning tower when they noticed that the water was rising rapidly, and the hatch through which they had come up had been closed. They made excellent time down the outside ladder and along the deck to another hatch that was still open.

Skip Dawson was in the hospital last year for two operations, both completely successful. . . . **Ray Dinsmore** wrote Alden in December that he was improving his physical condition by throwing away most of his doctors' remedies and substituting reasonable exercises. . . . **Ray MacCart** told me in January that he had sold his apartment in Pompano Beach, Fla., and that he and Virginia were very comfortable in their Chevy Chase, Md., apartment, regardless of the weather.

Harold Mayer continues to enjoy the fine library in Milwaukee. He reads a lot of German literature, and thus extends his already good knowledge of that language. . . . In December, **Jim Reber** sent a note of best wishes to our new president, to our president emeritus and to your writer and class beggar. . . . **Al Sherman** wrote recently that on December 31, 1972, he retired from his position as librarian of the Harvard Musical Association, in Boston.

In his letter to Alden in December, **Bob Townend** said that a week of tests in a hospital in May, and subsequent treatment at home, unfortunately kept him and Maude away from our June reunion. . . . **Earle Turner** wrote in December that he was playing one-armed golf four times a week, hoped to break 100 soon, and in February last year had received from "The Yankee Golfer" its Special Recognition Award. He seemed to think that his left-hand writing needed improvement, but it doesn't. — **Charles H. Chatfield**, Secretary, 117 Steele Rd., West Hartford, Conn. 06119

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We've probably reached the unfortunate age where we can expect sickness and sadness. But, it's upsetting to see so much of it. Here, **Archie Morrison** and **Harry Murphy** are in hospitals with severe cardiac troubles. . . . **Louie Young** is in a nursing home trying to master the use of a walker. . . . **Bee** and **Charlie Norton** were in a bad auto accident on Martha's Vineyard. . . . **Jerry Coldwell** has had another cataract operation and as a result had to give up his activities at The Roosevelt Hospital in New

York. At the request of the Board of Trustees he will remain as an Advisory Trustee.

At the end of 16 years, **Harold Dodge** is giving up his job as 1916 Class Secretary. I'm sorry to see this, as he has carried on so very well. We wish these good fellows "all the best" with the hope they're going, soon, to pull thru to good health. . . . **Frank Murphy** sends greetings to you all from his retirement hide-out in St. Augustine.

Good **George Easter** gives us a fine, informative letter. Thank you, George for your interest and your kind complimentary words. I thoroughly agree with George that **Joyce Brado** is doing a great job for us as Class Agent, carrying on so well for **Ben Neal**.

"I was amazed to note in the November *Review* how many of our gang have passed on in the past year and decided I had better get a note off to you before my summons comes to join that famous caravan that we used to read about. To start with I want to most heartily second all the remarks that have been made about your wonderful performance as our reporter all these years. Without them we would certainly not be the Class Supreme if indeed we still existed as a class at all. And this leads me to congratulate us on having picked **Joyce Brado** as Ben's successor. Of course I have been fortunate enough to know her personally through Ben and she is really wonderful. She keeps track of 15 locally personally. Came over from Lockport to call on Margaret and me and had also been in to see **Ben Lapp** whom she reported in pretty good shape. For years she handled all Ben's correspondence with '15ers and I feel knows many of them 'personally' as a result. Nobody else in our gang could come close to doing the job she can and will!

"We in XIV were of course one of the smaller groups (**Ed Walker** was one) and did not get to know a lot of our classmates. Even I feel I am on the fringes, having set foot in the Cambridge buildings exactly three times in my life! I have been notified that as of December 31 I will have earned my last salary check ever. With 16½ years past retirement age they feel it is time to give some of the kids (aged 60-65) a chance. Actually I have only put in a few hours a month for years but that is now ending. OK by me! We spend most of each summer at our 'camp' in the Adirondacks near Saranac Lake where I get a lot of exercise cutting firewood. There is a nice lake within 20 ft. of our dinner table and I guess there are some fish in it but I never chase them. Then when November comes, we vote and head for Florida for the rest of that month only. Our nurse daughter, who you may remember went to China a year or so ago, is now in Tallahassee so we drop in to see her coming and going but head for a nice motel in Treasure Island where we can watch the sun set in the Gulf out of our windows. My wife is an ardent swimmer in their heated salt water pool but I take very little of it. This year we fortunately headed home one day late so missed the big snow south of Cleveland or we might be stuck there yet! We must have passed at least 100 cars, empty and abandoned along with a lot of trucks, some in the ditch. We finally got into a line of trucks moving at snails pace for maybe 30 miles but after that there was no trouble all the way home. Lucky!

"Here the weather has been mean and miserable but not much below freezing and

we can still see the grass in our yard. Buffalo does not get nearly as severe winters as Rome or Syracuse further east but I do not recommend it as a winter paradise. We have a nice warm house and a snow blower and a wonderful neighbor to fix things that get busted and a lot of friends around town so we would rather be here than lost down south. As you can see, our health seems to hold out pretty well. Hope yours does too!"

Next month you will receive notice of our 60th Reunion; it will be a cocktail party and dinner at the Faculty Club here on June 6, Alumni Day. This will be free to all classmates and their families. Write when you can and help me to live up to the reputation George gives me above. I'll always be glad to hear from you. — **Azel W. Mack**, Secretary, 100 Memorial Drive, Cambridge, Mass. 02142

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It is timely now to remind you that we will be returning to The Chatham Bars Inn on June 3-5 (Tues. - Thurs.) 1975 for our 59th Reunion. It has been a great spot for us for 20 or more of our reunions and we look forward to more of the same and another good turnout. We understand that M.I.T. '30 will be there for their 45th at the same time. Heard from **Dave Patten**: "The record of reunion events, class pictures and 'commentary' on world events was carefully set aside for rereading and has just come to light. It's very interesting to find an erudite group of college grads, especially from M.I.T., expressing such conservative thoughts on the nation's status. They are out of step with the highly charged atmosphere back at the old school. In fact, great technological strides of the past quarter of a century, in which M.I.T. has been a leader, call for a period of gestation such as we are now going through. Sloughing off the old thoughts and practices has always been a painful process. In the past, war was the cleansing agent but I really think, with the exception of 'brushfire' happenings, the world is a better place to live in and generally speaking, so is homo sapiens."

Willard Brown writes: "I was delighted to open the *Tech Review* today and find the account of our 58th Reunion. Every name rang a bell in my memory — which is still pretty good but when I tried to tie memory in with more years of age, etc. in the photo of our 58th I had trouble. Surely I would have given a great deal to have been there but I simply couldn't. Not health — for both Dorothy and I enjoy about as good health as we have any right to expect. (I will be 80 in March and she is only 1¼ years younger.) We still try to live our somewhat extraordinarily active life. Just too many things to do. Recently I had to turn down a seat on the board of our Santa Barbara branch of the English Speaking Union, to which we both belong — just no extra time whatever! We do find that we tire a bit more quickly. I do get Dorothy down to Los Angeles, 100 miles away, occasionally for plays, music, etc. Had to miss my 60th Reunion at the V.M.I. last June (I drove from here for my 55th there); and I haven't been back to Midland Michigan and Cleveland Ohio for several years now, to visit my daughter and son and their families. But we have such a delightful life together here, that I really shouldn't growl. So we never seem to have a spare

moment. One thing in passing — as I may have mentioned to you I was in *Who's Who In America* for quite a few years, back in the late 40's and the 50's. When I retired from G.E. in 1960, they took me out. Now, I guess on account of some honors after my 'retirement', I am back in it again, in the 1974-75 volume just off the press."

Recent word from **Francis Stern** indicated that he is "recovering from heart attack of last March — which prevented attendance at the class reunion in June. Leaving for Palm Springs, Calif. November 29, 1974 until early April. Hope to be able to golf as recovery seems to have progressed O.K." ... We had this note from **Charlie Lawrence**: "Lois and I are settled in warmly for a long, cold, snowy winter but envy the classmates who travel the world for changes of scene, climate and adventures. See you next reunion!" ... **Ed Parsons** writes: "Survived the America's Cup Races which we could see from the sun deck of our home in Jamestown, R.I. It was no contest. My arthritis now interferes with my golf but I still swim and fish. Mary and I celebrate our 50th wedding anniversary, July 22, 1975; God willing. We have loved our home in Isamorada, Florida for 13 years." ... After many years of dedicated service, **Joe Barker** has resigned as our class agent. There is no way that we can properly express our thanks to Joe for all that he has done for our class. Who can ever forget his dramatic entrance as special gifts chairman to present the record-breaking 50 year gift of the Class of 1916 to Dr. Killian. Our 50th reunion report summarized it this way: "Then: the cannon shot starting off the parade giving the audience a sharp shock announcement that something important was about to happen; the Bucentaur parade headed by two 10-year old heralds, then the 1916-banner bearers **Bill Barrett** and **Harold Dodge**, and the barge with the gift-bearer **Joe Barker**, Oarsmen **Peb Stone**, **Cy Guething**, **Dick Hunneman**, **George Hale**, **Art Shuey**, and **Saul Hoffman**, plus barge pushers **Jim Evans** and **Bob O'Brien**; Joe Barker as the plumed discoverer and toter of a real Golden Fleece in the bow of the ship and presenting it to M.I.T. chairman Killian in coin of the realm in Morocco-bound best wishes of the Class of 1916; Joe's difficulty in adjusting his helmet to accommodate his trifocals as he made the presentation: the multi-throated gasp as the 3.1 million figure was announced; our kudos again to Joe for his marvelous work in building up the 50 year gift and to the many who made it possible."

We are grateful to Sumner Hayward, Secretary '21, for notifying us of the sudden passing of our classmate, **Stewart Keith**. Stewart suffered a heart attack on Christmas Eve and died one week later. Stewart's wife, Jessie, had preceded him in death in March 1974. Prior to his death, in his Christmas letter, Stuart wrote of a "new chapter in my book of life. It is centered around my two sons' families here in beautiful northern New Jersey. I have a room of my own in each of the homes with many of my keepsakes around. Averill's family includes two youths still living at home and exciting news from the three who are away (including one in Alaska). Bradford's family includes a daughter who lives in Denver (a real mountain climber), one married son who lives nearby and has a brand new baby, one son still lives at home and one son in

college. So you can realize that I'm in a whirl at either home." Both Stewart and Jessie were at our 50th.

We regret to report the untimely passing of Eleanor Webster, wife of our classmate, **Don Webster**. Eleanor and Don have been regular attendees at our annual reunions. The notice read in part: "She was the daughter of Max and Blanch (Going) Zach. Her father was a conductor of the Boston Pops Orchestra and the St. Louis Symphony Orchestra. He also played the viola with the Boston Symphony Orchestra. Mrs. Webster leaves her husband, Donald B; four sons, Donald B. Jr., of Toronto, Canada; David Z. of Needham, Peter Z. of Rochester, N.Y. and Philip J. Webster of Westwood, and 14 grandchildren."

Remember — make your plans now for attending our 59th Reunion. Our best wishes to all for continued good health. Keep your letters coming. — **Ralph A. Fletcher**, Secretary, West Chelmsford, Mass. 01863

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Edwin E. Aldrin Sr., father of "Buzz" Aldrin Jr., died on December 28. A retired Air Force Colonel, Ed had contributed much to U.S. aviation since he started as a World War I flyer when he served in the Aviation Section of the Army Signal Corps. He was a founder of the Aeronautical Engineering School, now the Air Force Institute of Technology. He served as a director of the aviation division of the Standard Oil Development Co. and managed the Newark Airport at one time. Ed was one of several of our classmates who have made really monumental contributions to our military and commercial aviation development.

Alumni of M.I.T. have always had special interest in the Franklin Institute in Boston. The codicil to Benjamin Franklin's will provided that 1000 lbs. sterling (then about \$4400) be left to the inhabitants of the Town of Boston to be loaned out at interest to young, married artificers, to assist them in starting their own businesses. The interest was to augment the principal and at the end of 100 years part of the fund was to be expended for public works and the balance was to be compounded for another hundred years.

When the first part of the fund matured before the turn of the century, the board of managers decided, after public hearings, that an opportunity school of engineering and science would constitute the most appropriate way of accomplishing Franklin's beneficent purpose. In 1904 Dr. Pritchett, then president of M.I.T. and chairman of the board of the Franklin Fund, visited Andrew Carnegie in Scotland. When Carnegie was told the dramatic story of the Franklin Fund, he replied tersely, "I'll match Ben Franklin." The value of the first part of the Fund had reached \$432,000 at this time and the building was started in 1907 on land provided by the City of Boston. The Institute opened its doors on September 21, 1908. Initially it offered only evening courses in science and engineering and the necessary preparatory courses.

After World War I the need for engineers, as well as the need for returning veterans to complete their education at this level, justified the addition of day courses to provide training in these important fields. In 1957 the Institute was awarded the right to

grant the degree of Associate in Engineering, which was an important milestone in the development of the school. The Institute has trained more than 80,000 young men and women for useful careers in industry and the community. We can be grateful to Dr. Franklin for a highly imaginative approach to benefit society.

Al Lunn has been associated with the Franklin Institute for 40 years. It took an order of the Massachusetts Superior Judiciary Court for Al to become president of the board 22 years ago. The Franklin will stipulated that the president be a citizen of Boston, virtuous and benevolent. Al lived in Cambridge, hence the need for a court order. It was forthcoming but only after a judge inquired if it was to be concluded that there was no honest citizen in Boston. The school plans to merge in 1975 with Boston University to be the Franklin School of Arts and Sciences.

With **Dick Loengard** celebrating his 78th birthday on January 2 we now have only **Bob Erb** not yet 78. Did they take IQs in our early days? Bob and Pat were away to Hawaii in January. The many friends of Ruth Dennen will be glad to know of her well-being and Christmas time with her family. ... **Tom Meloy Jr.** who was vice president for research and development with his father in Meloy Laboratories has been appointed division director for engineering for the National Science Foundation. ... **Luther Lauer** after 1954 retirement from Allied Chemical traveled extensively in many areas and now enjoys living in Orchard Park, N.Y. ... **Harry Wansker** is a director of the M.I.T. Club of southwest Florida at Sarasota. ... **Joe Littlefield** may not have given up his real estate activities, but if so he is more than correspondingly active in security advising. Comprehensive listings are available from him at 6816 Altamira St., Coral Gables, Fla.

Here is the last of the names of men who responded to our Northfield reunion notice: **Cook**, **Bill Eaton**, **Kittredge**, **Catlett**, **Roland Eaton**, **Wells**, **Martin**, **Beattie**, **Logan**, **Perry**, **Lee**, **Dowell**, **Waite**, **Storrow**, **McDougall**, **Dickson**, **N. Stevens**, **Wansker**, **Gannett**, **Johnston**, **Batschy**, **Meloy** and **Venable**. All responses were appreciated.

David E. Waite died November 20, 1974 at Bath, Maine. He spent 33 years with the Associated Spring Corp. of Bristol, Conn. retiring in 1959 as chief product engineer. **Arthur E. Dowell Jr.** died July, 1974 at Arlington, Va. — **Stanley C. Dunning**, Secretary, 6 Jason St., Arlington, Mass. 02174; **Richard O. Loengard**, Assistant Secretary, 21 East 87th St., New York, N.Y. 10028

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I am in a very cheerful mood — thanks to the many year-end greetings received from you with good wishes for the New Year. By the time you read my acknowledgements in these columns there will be a considerable time delay — but I am flattered and happy with your felicitations and news. Beautiful cards came from the **Sax Fletchers**, **Mal Barbers**, **Craig Hazelets**, **Charlie Watts**, **Peter Strang**, **Wingate Rollins**, **John Kilduffs**, **Bertram Jones**, **Len Levines** amongst others.

Longer messages are being reproduced herewith. Because of space considerations

some will appear in succeeding issues of the Review. Here is Herb McNary's note: "Your classmates owe much to you for keeping them on their toes rather than letting them curl up. In response to your questions, Marion and I again returned to Bermuda, the scene of our honeymoon 44 years ago almost at the time you and Selma spent your honeymoon there. I try to keep on wearing several hats. Your reference to 'technology' reminds me that I filed legislation for the Massachusetts State Chamber of Commerce calling for a study to extend regionalization by cities and towns of service and functions. Our state's heaviest burden has been the Local property tax. Small as Massachusetts is geographically, we have 351 cities and towns, many contiguous small communities going back to Colonial days and unable individually to take advantage of modern technology in local operation which can be done more efficiently and at great savings by regionalization, such as had to be done with high schools."

Charles Dimock writes from New Hampshire: "To all the boys in '18, section 15 — if I remember correctly — who have survived the 'storm' of life. I'll think over giving a life synopsis to be published in the M.I.T. Alumni Magazine. Got to mail this card now, the pick-up is at 2 P.M. and I only have to walk a hundred yards to the box. I'm in the old business district but the Hood Plaza is a 15-store unit with plenty of parking space on route 28 — $\frac{3}{4}$ of a mile away."

From the warm climate of Florida, **Fred Philbrick** notes: "We trust that you are both well and not too much disturbed by the inflation which bears down upon us. I have planted some tomatoes in our back yard garden as a small gesture against the high food prices. We also have our oranges, mangoes, figs, grapefruit, avocados and bananas. I enjoy watching them grow. Last April 1 had my fifth pacemaker installed. I should be good for another two years."

Going out to the west coast **Edgar Goldstine** reports: "The biggest change in the past year is moving into an apartment with a view of San Francisco Bay and half of the Golden Gate Bridge. Still working as a Safety Consultant, doing about one third of what I used to do, but it is as much as I wish. I make inspections of buildings under construction, and occasionally go to court as an Expert Witness in public liability cases. Enjoying my work, good health, the families of our two sons and three grandchildren."

Still out in the far West here are some observations by **Harold Weber**: "Thank you so much for your holiday greetings. On reading the class notes in this issue of the *Technology Review* I was shocked to hear of the passing of **Al Grossman**. Al and I were close friends. I knew him well as a student but lost track of him for a few years after graduation. During these years I became a consultant to Stedfast Rubber Co., which at that time was owned by his father-in-law. I continued as a consultant to Stedfast for I guess about 30 years. During that time Al's father-in-law died and Al took over as president. Our friendship continued all thru the years. He was a fine man, kind and retiring — everyone liked him. Please express my feelings to his wife."

"As for my activities — I gave up my consulting practice about two years ago and last spring retired as a senior consultant to the U.S. Army with over 30 years activity."



Left to right: Pete Harrall, John Kilduff, Julian Howe, and Max Seltzer at the 1918 mini-reunion in October, 1974 at Endicott House.

Marion and I record for the blind two mornings a week. We record on tapes texts which blind students will use in their high school and college courses — all over the United States — this activity is nationwide. Marion does volunteer work in the local library one afternoon a week.

"I have a small metal-working shop as a hobby — one of many years standing. Once in a while I do a little in electronics. This, with two or three vacations a year, and keeping up in chemical engineering, keeps us as busy as we want to be. Possibly if I can get my thoughts organized I may write to you about my thoughts concerning the present economic mess from an M.I.T. chemical engineering viewpoint. You know, scientists and engineers as they get older also get philosophical — but it does seem that some sound M.I.T. reasoning could be of assistance in our present problems. As you can see, my writing has not improved over the years — but I don't think it has deteriorated either. My best to you and your good wife."

Coming back to Florida, news came from **Harry Levine** that he underwent a serious operation. He was in the hospital for three weeks and is at home slowly regaining his strength. . . . The **Pete Harralls** have returned from Russia — we expect to receive their notes about this trip for a future issue — in the interim we are indebted to them for the snapshot taken at the October mini-reunion.

Jumping back to California, here is news from **Wendell Monroe**: "Your card showing the picture of the main M.I.T. building is beautiful. Thank you and Merry Christmas and Happy New Year! I am now 80½ years old but feel pretty good most of the time. My wife and I live a quiet retired life. We love California. We are only a couple of miles from the Pacific Ocean and a breeze from the ocean blows over our home nearly all the time, so no smog, thank God. We have kind memories of the east and midwest, but will not get back there, in this life at least."

"About technology, of course it can and will solve most of our societal problems. An engineer is defined as an applied scientist (technologist) which means he uses science for the benefit of man. A pure scientist is just after knowledge usually. Both are valuable, of course, but I prefer to be an applied scientist (engineer)."

We continue our *hegira* this time with two epistles from Texas from **Giles Hulseman** and **Bob Gidley** — the first from Giles: "Responding to your kind note, my biography would interest no one else, but my health is so good it actually seems to be improving. I still jog an hour every day and surprisingly, have done all my reading the last year without any glasses at all. We live in Colorado Springs in the summer and here in winter, because of the weather extremes in Kansas City. Can always be found by phone. I turn to your notes first every issue and feel greatly indebted to you. Thank you and Happy New Year."

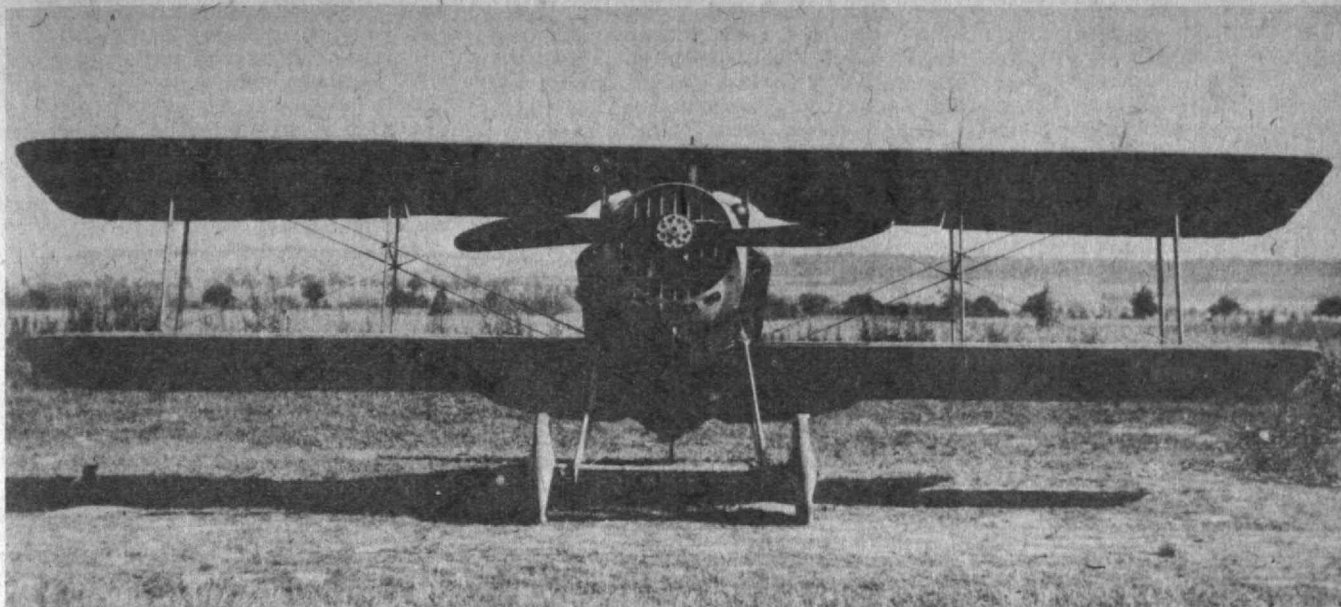
"Most of my news already has appeared in the *Review*. Most important news of 1974 was the arrival of a great granddaughter — my third great grandchild. Will be 82 in January so don't get very far from home base these days. I like to be active but take it easy and try not to overdo. However, they did renew my driver's license for four more years last week and the doc says that I am in good condition for a man of my age. I keep in touch with two of my 1918 Course IV classmates by letter. **Palmer Giles** lives about 300 miles away on a large Texas ranch and **Herb Hatch**, a one-time M.I.T. roommate still resides in Wollaston but goes south for the winter months. He keeps me posted on what is happening in Boston when he is there. Sorry I don't have more news to give out. You are doing a fine job and I always turn to 1918 when the *Review* comes in. With best wishes for a Merry Christmas and Happy New Year."

Jim Flint jumps around from Montana, Mich. and New Zealand: "Thanks for your card. Things are quiet with me since Mrs. F died. I have been fishing in New Zealand several times and spend close to five to six months at my place in Montana in the summer time. I am quite well and fit (for my age)."

Your secretary with his Selma together with Elizabeth and **Julie Howe** represented you at funeral services for **Samuel V. Chamberlain** on January 14, 1975 in Marblehead, Mass. It has been my good fortune to have seen quite a bit of Sam these past few years — and I feel a deep sense of personal loss as I know many of you do who were privileged to know him. Rather than reproducing the obituary review in the newspapers which was well done I print herewith an article by a close friend and art critic (Robert Taylor of the *Boston Globe*) entitled "Samuel Chamberlain — Etched in Sunlight."

"Samuel Chamberlain passed through more New England doorways and savored more of the bouquet of the New England he loved — old timbers, generous hearths and deep-panelling — than any other artist, but he was a far from provincial figure. In fact, he was world-famous. Decade upon decade his prints, photographs, gastronomic memoirs, cookbooks and occasional writing poured forth in seemingly inexhaustible abundance; and it is perhaps typical that when he was in the midst of showing a visitor the proofs of his autobiography not long ago, a Japanese delegation arrived to see his kitchen in Marblehead."

"He belonged to a brilliant generation of American etchers whose hallmark was craft: John Taylor Arms, Arthur Heintzelman, Kerr Eby. They sustained exacting standards as with the years the high art to which they had devoted their talents gave



"When a Pilot had to Wear Boots and Spurs . . ."

The Jenny, Nieuport, Spad, Camel, Bre-guet, Farman, Caudron, Voisin, Salmson, Liberty — all of them were flown by Stuart E. Elliott, '18, during World War I. What was it like? Read his book, *Wooden Crates and Gallant Pilots* (Philadelphia: Dorrance and Co., 1974, \$7.95), in which Mr. Elliott "tries to tell a part of that story by recounting the experiences of a more or less typical trainee and combat pilot during the period 1917-1919."

Picture the world as it was then. In 1917, driving from New York to Boston was different. "There were no parkways, [or] free-ways . . . seven to eight hours between New York's 59th Street and Boston's Copley Square was good going, for the environs of cities and larger towns had miles of cobblestoned streets that were crowded with horsedrawn drays and slow, ponderous wagons, and bisected with trolley tracks that often gave little room for a car to squeeze between the trolley cars and the curb."

Compare the difference in flying then and now: "... Military flying was then a very individual business . . . when planes were crates, engines as uncertain as a mule's behavior, and an airborne flyer was free as a bird to choose his flight route and level. . . . Like an old-time sea captain he was master of his vessel, even if once again on the ground, he might have to wear boots and spurs and know how to present arms with a sword."

Imagine Mr. Elliott's experience of combat in one of these planes. "I had been flying tail-man-high, a sort of rear guard, rover position in our six-plane patrol, when, emerging from the top regions of a huge cumulus cloud, I lost contact with my flight and was alone. Looking around to find them, I became aware of a big black Rumpler not far ahead and about 1,000 ft. below, in a most favorable position for me to attack. . .

"Without a moment's reflection that this Rumpler might not be so easy as he looked, and neglecting to look in back and above, I started down on him. Then, the blue sky was suddenly threaded with filmy white traceries, things that resembled golden

oranges flashed and streaked past my plane, there were sounds like *wha-wha-wha-wha*, and I turned my head to see the goggled, owl-eyed, smoke blackened, triumph-grinning face of a Hun pilot nosing down, and not much more than 50 ft. behind my tail. Here was Death all in black leather, Dracula in a helmet ready to pounce, and not far behind and also diving for the kill were three other Fokkers.

"... I do remember jerking around, much as some show-off rider might jerk around the head of his saddle horse, and sharply peaking up to spray a burst at this attacker, causing him to swerve, and zoom away for a moment. Then my engine seemed to labor, my all-but-vertically-nosed up Spad went soft in the thin, 16,000-ft. air, and I was in a spin, straight down with full motor. Down I spun, since it seemed now the only thing to do, and dead below, the tiny ruined steeple of the village church at Flirey stood like a little rotten tooth at the hub of a turning map.

"Then, for some unknown reason, the enemy suddenly left me, and, aware for the first time of my roaring and wildly vibrating engine, I throttled it. I came out of the spin and dive at 10,000 ft., and on landing at our field, it was found that the flying wires had been stretched several inches from the strains of the dive and that my wings had come very close to leaving me. However, the whole business had been a good lesson."

Stuart E. Elliott was born in Osterville, Mass., in 1892. He enlisted in 1917 and served in the A.E.F. as first lieutenant, and most of *Wooden Crates and Gallant Pilots* is devoted to capturing the atmosphere of World War I aviation through the vivid telling of many varied incidents, involving friends, humor, sadness, combat. Much of it is personal reminiscence, but it could all well be the story of any contemporary combat pilot; the setting, the governing forces, were similar for everyone involved. Some of Mr. Elliott's later adventures: gold and silver mining in California and Nevada, crewing in a Bermuda Schooner race, participating in an arctic expedition on a Norwegian seal ship, traveling extensively throughout the

world. He rejoined the Air Force in 1942 and served in Guam and Japan.

Today, Mr. Elliott lives with his wife, Alice, in San Rafael, Calif. There they lead "a rather quiet life, enlivened by attending the races." □



The plane (top) flown by Stuart E. Elliott from about July 1, 1918 until the armistice is a model Spad XIII, with a 220 hp. Hispano Swiza motor, a wooden Belleau propeller, and two 30-caliber machine guns capable of firing together about 500 rounds. The plane could carry, in addition, two 25-Kilo bombs, climb to 10,000 ft. in ten minutes (where its top speed was close to 140 m.p.h.), and cruise very well at 15,000-18,000 ft. Its top ceiling was around 21,000 ft. "There was no parachute," Mr. Elliott said, "and no armor, and the chief danger was fire from an incendiary bullet, or a gas tank leak ignited by a chance spark. It was very rugged otherwise." Above, First Lieut. Stuart E. Elliott (center) in 1918 with the late Henry (Hank) Stovall (left) and the late David Howe (right).

way to movements alien to their temper. They never surrendered their craft, the sense that things should be well and truly made. Samuel Chamberlain was a consummate copperplate etcher. To watch him clean a plate, wax it, smoke it, needle the line, apply stopping out varnish, immerse it in acid, clean it and print a proof was to observe an act of primal and pure art.

"In certain respects he was fortunate to have roots in an age when photography, which he was ironically to practice so well, did not monopolize the pages of newspapers and magazines. This enabled him to cultivate pen and pencil drawing. Studies of architecture stood high in his esteem. The curator of the Wiggin Collection at the Boston Public Library, Sinclair Hitchings, has declared that to know Samuel Chamberlain's art one must know his drawings. Of these among the most notable are studies of French brick buildings done in the Twenties and Thirties, and drawings of North African and Egyptian architecture made in World War II. 'The French drawings are uncanny,' says Hitchings, 'in their successful attempt to combine an empirical assignment — suggesting with a pencil the weight and size of bricks in the fabric of buildings often both large and elaborate — with the artist's suggestive approach to light, atmosphere, distance, and necessarily, too, of detail.' Once seen, a Chamberlain is etched in the viewer's memory.

"His delight in the culture of France continued from the time that he helped pick the grapes of the 1917 vintage in Champagne during a lull on the Western Front, to the last day of his life. His first book, in 1924, was 'Vingt Lithographies du Vieux Paris,' and certainly among the many highlights of his work must be accounted the drypoints of Senlis, Chartres and Paris in the early Thirties. But who would forget the moment, when total night had settled upon the Continent, of the appearance of Samuel Chamberlain's 'France Will Live Again'? Or for that matter, his later 'Flavor of France'?"

"He was quiet and modest. He was kind, sensitive, patient and, in a world where the civilities seem to suffer the fate of high art, infinitely civil. His extraordinary talents entitled him to recognitions of various sorts, but he was happiest perhaps at a sunny picnic table, with an honest wine, and the company of children, whom he adored. The 1917 was a vintage Champagne to be remembered; Samuel Chamberlain constituted a vintage himself, of the most cherishable human qualities."

Thru the courtesy of good friend Bob Dawes, '24, I record the passing of **Howard Simonds** as reported in the *Hudson Daily Sun* January 8, 1975: "Howard Simonds, 80, of 16 Warren Ave., died last evening at Braemore Nursing Home. He was the husband of Amy (Allen) Simonds. He was born in Marlboro, the son of Mr. and Mrs. Silas E. Simonds and was a resident of Marlboro for 50 years. Until his retirement he was employed as an engineer at the former Lapointe Machine Tool Company. Besides his widow he leaves a brother, Warren Simonds of Orange and a nephew Herbert Stevens of New York City. He was a member of the Unitarian Church and a graduate of the Massachusetts Institute of Technology."

It is my very sad task to report the deaths of **Leslie N. Iredell**, on October 9, 1974, **Raymond S. Smith** on October 16, 1974,

Philo S. Shelton on June 5, 1974, and **Samuel F. Fuller** on January 17, 1975. — **Max Seltzer**, Secretary, 60 Longwood Ave., Brookline, Mass. 02146; **Leonard Levine**, Assistant Secretary, 519 Washington St., Brookline, Mass. 02146

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A letter from Mrs. Dehon announced the death of **Theodore Dehon** on October 13, 1974 after being hospitalized in Florence, S.C. while on a visit to her sister in Darlington, S.C. "He had a heart attack on September 13 and remained in the hospital. A heart pacer was implanted — but he became allergic to the medicine and at the end, his one kidney failed. He left three children and was a generous and wonderful father to them."

A letter from David M. McFarland, '18, about the late Rehn Smith who passed away in September follows: "Several years ago we stopped to see Rehn and his wife on our way to the Williamsburg Antiques Forum and had a delightful visit with them. As I am a one-acre farmer, I was much impressed with the attractive home and acreage Rehn had. Never had we seen a kitchen with beautiful oriental rugs. I understand they were collectors of them as we are of antique furniture."

I had a note from Eleanor Muller (wife of the late **Otto Muller**) last week. She has a granddaughter at Kenyon and we have a grandson at Denison. The schools are but a few miles apart." . . . A note from **R. B. Johnson** says: "I spend six months in Nokomis, Fla. and six months in Franklin, N.H. I have more to do than there is time to do it in."

Leighton B. Smith writes: "The gas shortage upset our plans to photograph humming birds on spring migration in Arizona. Except for two weeks fishing in Maine, we have kept busy all fall with the Mass. Audubon Exhibit of Nature Photography of which Adelaide has been slide chairman. In early October we had dinner with classmate **Lou Grayson** and his wife Aline."

We have heard from **Richard S. Holmgren** who says, "I am still active with my airstream trailer. We spent August-October in the Canadian Rockies — wonderful country. Have taken up square dancing which is lots of fun and excellent exercise. Also take a bicycle ride each day of a couple of miles. My wife keeps up with me." — **E. R. Smoley**, Secretary, 50 East Rd., Delray Beach, Fla.

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A gratifying number of Christmas and New Year greetings received and welcomed in this, our reunion year, including the **Al Burkes**, the **Buzz Burroughs**, the **Bill Deweys**, the **Dick Gees**, the **Jim Gibsons**, the "Toots" **Kinghorns**, the **Art Merrimans**, **Ned Murdough**, the **Stan Reynolds**, the **Ed Ryers**, the **Lee Tomases**, the **K. B. Whites**.

Congratulations are in order for Gertrude and **Jim Wolfson** who celebrated their golden wedding anniversary late last year in Florida with their three sons and wives and three of their five grandchildren. . . . **Carleton Alexander** writes that he and Helen ob-

served their 51st. They have two children and six grandchildren. Their house is in Wickliffe, Ohio, and he gets together with **Art Merriman** once in a while. Carleton avers that they lead a quiet life but one is inclined to question this when he admits that his Helen decided last summer that it was time she learned to ride a bicycle, which she did, "only falling off a few times," says Carleton, "and breaking no bones." Then just as she was putting the bike away at the end of the season she tripped over a pedal, cracked a bone and was laid up for four weeks, "but it was worth it," she says. Hats off to you, Helen! The class salutes you. Carleton says way back in the 20's and 30's when he was occupied above the Arctic Circle in Alaska she used to enjoy flying up there with the bush pilots, landing on river sand bars or the tops of ridges in summer and on frozen lakes in winter. He used to worry about her then but not as much as her conquest of the bicycle.

Heinie Haskell reports that he has checked in for the winter at Hilton Head Island after a fine summer at their Connecticut home. He says his craft, *Monsoon III*, is in great shape for the series of winter races. Heinie still keeps his hand in as chairman of the Brunswick Worsteds Mills. . . . A welcome note from "**Snug**" **Etter** indicates that he is enjoying life in Hillsborough, Calif. We agree with him that this lovely town on the Peninsula south of San Francisco is a great place to live.

A feature article in the *Miami Herald* contains a couple of impressive color pictures of our distinguished classmate, **Sam Schenberg**, one showing Sam wading along the beach selecting suitable seaweed for his art project which has been on exhibition at the Miami Beach Public Library. Quoting from the feature story, "Schenberg is a youthful-looking man who admits to being 'past 65.' This thing of retirement is a myth," says Sam. "There's no greater joy in the world than working with others, and working with children brings the greatest return. In 1970, shortly before retirement as director of science for New York City's school system, Sam founded an Environmental Resource Council to help raise the caliber of general education in the city." The idea was to get people to see that education takes place not only in classrooms but also out of doors, and, since I was always interested in water, it occurred to me that the beach was teeming with life and we could provide a lab right there." So he wrote a book called *Adventures on the Beach* as a guide for teachers. Sam has developed a unique art form, pressing seaweed in a flower presser and framing it to resemble miniature foliage. Sam continues to be active as a volunteer worker in the country's school system. "I've been lucky," says Sam, "possibly because I don't compete with anyone. I've volunteered my services many times and have been accepted." No wonder, Sam. Commenting on the newspaper article Sam says, "for the first time in the history of civilization we have the largest congregation of retired people living in the Miami Beach area. Since there is no virtue in rediscovering something that was discovered years ago, what use should be made of the knowledge, experience, and professional contacts of this group? The interest seems to be growing. Perhaps our colleges and universities should research the problem."

Winifred Griffin writes a thoughtful note about the death, on November 30, of her husband, Sid, of 300 E. Washington Blvd., Lombard, Ill. Sid died of a heart attack having had two previous attacks. Up to that time he had enjoyed golf and many other activities. Winifred says he used to enjoy reading about the class activities in the *Review* year after year.

Another widely known and distinguished classmate whose death occurred on November 12, 1974 was **Harold Bennet** of 5072 Tennyson St., Denver, Colo. Harold was a noted reclamation engineer serving for 41 years with the U. S. Bureau of Reclamation. He supervised the design of numerous power plants in the western United States including those at Hungry Horse, Shasta, Glen Canyon and Grand Coulee Dams. During World War I he was an important factor in converting the cavalry to mechanized units. He was a life member of the Colorado Society of Engineers, a charter member of the Denver Chapter, Archaeological Society, a member of the Denver Museum of Natural History, the State Historical Society, the Denver Zoological and Botanical Gardens and a charter member of Historic Denver, Inc. He is survived by his widow, Edith, a son and two grandchildren.

As these notes reach the deadline, a bit of happy news comes in from **Harold Bibber**. Since his remarriage in 1973 Harold and his bride have traveled to Australia and New Zealand, then summered last year in upper Michigan, and are now enjoying the sun and beach on Sanibel Island off Ft. Myers, Fla. Their regular home is now in Columbus, Ohio. — **Harold Bugbee**, Secretary, 21 Everell Rd., Winchester, Mass. 01890

21

Most of the class news this month has been garnered from notes on Christmas cards. It was wonderful to hear from so many, and your secretary thanks all of you who wrote. Wouldn't it be wonderful if next Christmas everyone in the class sent a newsy letter! Do I hear any New Year's resolutions?

A wonderful long letter from Ceil and **Frank Huggins** of Frogmore, S.C. contains a sketch of Frank shooting down what looks like hornets nests in a tree. The text says: "no, they are parasites," otherwise known as mistletoe, which the Huggins used for their Christmas decorations this year. Ceil has been doing graduate work this past year at the University of South Carolina — a drawing course so that she can compete with Frank's sketches. Every one else in her class was about the age of her grandchildren, but apparently they made her feel part of the group. The Huggins report that after a good vegetable garden the year before, the rabbits took over and left little more than onions.

The annual Christmas letter of Maida and **Ed Dubé** relates the doings of their children and grandchildren. Their two foster daughters are playing the violin with symphony orchestras, Eva with the Montreal Symphony and Ikuko with the Boston Symphony. Maida keeps busy with Women's Club and church study groups and Ed still maintains a Boston office, but is doing little professional work. Planning for our 55th Reunion is on his agenda for the coming year.

The card from Beth and **Whit Spaulding**

had a delightful sketch of "All Saints by the Sea, Boothbay Harbor, Maine." The artist? Beth Spaulding. They expressed a hope of seeing us in Sarasota this winter, and we expect to see them before these notes appear in print. We are looking forward to one or more mini-reunion luncheons in Florida during February. . . . Family photographs on cards from Helen and **Bob Miller** and Marion and **George Chutter** added to our Christmas joys. Bob had ten of his grandchildren lined up on the fence — a heartwarming group of clean looking kids. George wrote that their summer pleasures are always enhanced by having the Millers and the Lundens on Cape Cod. "Both Bob Miller and Sam Lunden have been guest M.C.'s at our weekly coffee group."

Betty Patton writes from Dallas, Penn. that her office has been completely restored following the disastrous flood of the previous year. Says she, "I have become a complete needlepoint and bargello addict. [What is that?] My summer vacation patterns are changing — visited friends in Yarmouth, Nova Scotia in August — my first trip there — just the right combination of the beaches of Cape Cod and the forests of Maine."

Millie and **Herb Kaufmann** wrote that their Mediterranean cruise plans were changed last fall when Cyprus erupted "so we settled for Spain which was very lovely." The Kaufmanns were planning to go to Pittsburgh to visit their daughter and grandchildren but except for that, planned to enjoy the winter warmth of Sarasota. . . . Helen St. Laurent had the disturbing news that her summer home on Vinalhaven was ransacked just before Christmas. An outboard motor was stolen, two fine old muskets, and old hand-made pitchforks and shovels. Her caretaker was uncertain about what else was stolen but Helen plans to wait until spring to go up and check. Helen spent a long summer in Maine and didn't return to Connecticut until late October.

Brief notes were received from Ruth and **Ralph Wetsten** of New York City and Hazel and **Whit Wetherell** of Cape Cod. The Wetherells took a trip to North Carolina in November to visit Whit's sister and while there visited Carl Sandburg's home in Flat Rock, now a National Historic Trust. Hazel, as a Simmons Library School graduate, was interested to learn that someone is finally cataloguing Carl Sandburg's library. During his lifetime, Sandburg's daughter wanted to classify the books but they remained "in pleasant chaos so Sandburg could find things."

Maxine and **Cac Clarke** continue to be busy as beavers in Brielle, N.J. Mac — a real pro artist — is doing a series of historical scenes in and around Brielle. Cac as co-chairman of the Brielle Bicentennial Committee is hot on the trail of a local Revolutionary War salt works and believes they have uncovered some ancient foundations. Cac's weekly column of "Bicentennial Briefs" in the *Coast Star* completed its first year in September. A picture in the November 28, 1974 issue of the *Coast Star* shows Cac receiving an award pin from the federal government's American Revolution Bicentennial Administration, honoring him for his achievements in the borough's Bicentennial program. The Clarks for the second year in a row attended the beautifully impressive candlelight Christmas Vespers at the old Moravian Church in Beth-

lehem, Penn., first held there in 1756.

Ruth and **Irv Jakobson** attended the annual Christmas cocktail party at the Dayton Brown's and in turn entertained the Browns at their annual oyster stew party. Jake reports that Dayton was in an automobile accident which ruined the Brown's car but fortunately Dayton escaped with only a few minor bruises.

From Alumni Fund envelopes we have learned of the deaths of two wives. **Don Lyman** of St. Petersburg, Fla. wrote that his wife Laura died on December 9, 1974. He regrets that he missed out on the Bardmoor luncheon last February and hopes that we'll get together this year. **O. Kenneth Bates** of Canton, N.Y., lost his wife in September, 1973. "We had been married 48 years. I am in fine condition and toured England and Portugal this past summer with my daughter and granddaughter." The class extends its deep sympathy to these two classmates. . . . **Tom Bartram** of Largo, Fla. writes: "It has been a privilege to serve as secretary and treasurer of the M.I.T., Club of Central Florida for two years. Please note the largest class membership is nine from 1921."

Frederick F. Olson of El Cerrito, Calif. reports "We still travel as sufficient funds are accumulated, but it becomes more difficult with inflation. Spent four weeks last August in Scandinavian countries including a cruise through the Norwegian Fjords. Also investigated my father's birthplace and found some cousins. Have been writing a family history."

A letter in early December from **Ed Dubé** brought the sad news of the death on December 8 of Helen Farrand, wife of our Class Estate Secretary **Ed Farrand**. She had been in poor health for a number of years and neither of the Farrands felt well enough to attend our 50th Reunion. Your secretary remembers the last time he saw the Farrands was at a luncheon at the Hotel Griswold at our 45th Reunion. Our deep sympathy goes to Ed. Letters to him at 5981 La Jolla Mesa Drive, La Jolla, Calif. 92037 would be appreciated.

Notices of two more deaths of classmates have been received: **Dwight V. Gregory** of Drexel Hill, Penn. on June 19, 1974 and **Henry duPont Baldwin** of Annapolis, Md. in September 1974. Gregory got a master's degree with us in Course V and was a research chemist with duPont. Baldwin entered M.I.T. in our freshman year, was active in undergraduate athletics and on the Mandolin Club, and got his S.B. in Course II. In his business career he was associated with Aircraft Marine Specialty Co. of Baltimore. The sympathy of the class is extended to their families. — **Sumner Hayward**, Secretary, 224 Richards Rd., Ridgewood, N.J. 07450; **Josiah D. Crosby**, Assistant Secretary for Florida, 3310 Sheffield Cir., Sarasota, Fla. 33580; **Samuel E. Lunden**, Assistant Secretary for California, Lunden and Johnson, 453 South Spring St., Los Angeles, Calif. 90013

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Greetings from sunny Florida and sunny Buffalo including sunny Cap Haitien and Cozumel on the *Renaissance*. Dorothy and I have decided that we look forward to our next Port of Curacao for some shopping. Our Florida golfing experience leaves us

hoping for a better score each day as we threaten to throw the clubs in the next lake and buy a tennis racket. . . . **Bill Meuser** was joined by his sons Bill and Bob at the Dais for the Award's Dinner at the New York Hilton on January 29. Bill and Edna are having a big family gathering in April to celebrate their 50th wedding anniversary. In accounting for their 11 grandchildren, two are young Bill's, two are Gayle's and seven for their son Bob. Congratulations to them all. . . . **Parke Appel** writes from Venice, Fla. that he has just received our picture postcard of the Barraca Restaurant in Madrid from April 19, 1974. We are invited to see Madeline and Parke in March. . . . This is too late to announce the M.I.T. Fiesta in Mexico at the University Club, but our class generally has good representation there. . . . **Don Carpenter** of Mendenhall, Penn. has invited us to stop for a drink as we drive through his section of the country. We also have a note with a similar invitation from the Spalding Inn Club, Whitefield, N.H., which is being considered for our 55th Reunion. They have welcomed Maude and **George T. Boli** of Sarasota, Fla., expert lawn bowlers, who completed their 9th consecutive summer with Anna and Randall Bunt. Others including Marion and **Norman J. Greene** from Berwyn, Penn.; Frances and **W. Raymond Hewes** of Needham; and **C. Yardly Chittick** now of N.H. is a practicing attorney.

We are glad to receive greetings from **C. George Dandrow** of Bronxville, N.Y. We hope to see George at our June get-together. . . . A note from **Broderick Haskell** of occasional world travel planned for this spring and summer. . . . **John W. Strieder** of Chestnut Hill, Mass. has been designated recipient of the "Henry Chadwick Medal" by the Massachusetts Thoracic Society for "Contributions to Thoracic Surgery." . . . **Elsie and John F. (Robbie) Robinson** of Sewickley, Penn. celebrated their 50th wedding anniversary with their three children, three children-in-laws and five of their nine grandchildren. . . . **Mrs. Martha E. Munzer (Elseman)** has written a new book with the help of her grandnephew, John Vogel, Jr. called *New Towns: Building Cities From Scratch* (Knopf, 1974). . . . **Edward J. O'Connor** is enjoying partial retirement with consulting capacity at Allied Chemical Company, who bought out Granite State Asphalt Company of Manchester, N.H. two years ago. Ed figured 50 years at the grindstone is long enough. He is playing golf at Delray Beach, Fla. with his handicap still 11.

Ronald G. MacDonald attended the American Institute of Chemical Engineers held in Munich, Germany in November, 1974. He also visited the papermaking school at Oskar Muller Polytechnicum in Munich. . . . **Lloyd A. Elmer** is still employed part time, as a consultant at Fairleigh Dickinson University, Madison, N.J. Lloyd writes: "My most rewarding course at M.I.T. was 'Applied Mechanics and Theory of Elasticity' taught by Prof. Charles E. Fuller." . . . **Fearing Pratt** of Hingham favorably endorses the suggestion that the Pavilion be named for Jack Wood. . . . **Mrs. Bertha S. Dodge (Wiener)** of Dearborn, Mich. has a granddaughter (Joan Hooper) in the freshman class at M.I.T. . . . **Irwin J. Smith** of Albany, N.Y. is retired and a semi-invalid. Irwin missed our 50th Reunion, but celebrated his 50th wedding anniversary in 1973. We hope Irwin will be able to attend

our 55th Reunion.

William B. Elmer of Massachusetts has written a book, *The Optical Design of Reflectors*, which was issued in 1974. The book has been purchased by nearly every major outdoor lighting manufacturer in the U.S. Bill has also completed an album of 16 concert pieces for piano: "Structures in Sound." . . . This is **William L. Hyland's** 49th year with Fay, Spofford & Thorndike, Inc. where he is senior vice-president. Bill is president of the Norwood Historical Society and is active in other civic affairs of Norwood, Mass.

We are sorry to report the loss of several members of our class and send their families our most sincere sympathy: **Lewis P. Tabor**, Narberth, Penn.; **Ralph C. Geckler**, Boca Raton, Fla.; **Herbert A. Hickey**, Portage, Mich. Also **Andrew Spanur, Jr.**, 615 Park Avenue, Long Beach, Calif. passed away December 1 at 79 years of age. He is survived by his wife, Margaret; son, Richard, and four grandchildren. Andrew was superintendent of Sherwilliams Plant in Cleveland, Ohio back in the 30's. He was works manager of Spencer Kellogg vegetable oil processing plant in Long Beach until he retired. . . . We have no brilliant repartee on address changes this month, therefore, we close with sincere best wishes to keep happy and healthy. — **Whitworth Ferguson**, Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; **Oscar Horovitz**, Assistant Secretary, 3001 South Course Dr., Pompano Beach, Fla. 33060

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Alexander F. Newman reports that he and Jennie celebrated their 50th wedding anniversary on June 23, 1974 and climaxed the occasion by taking a trip to Hawaii. . . . **Edwin M. Barnes** tells us that he was remarried to Jessica R. Tolmer. They are living in Fort Lauderdale, Fla. Their son moved his family to Stuart, Fla. in July 1974, where he is engaged in the printing business. . . . **Thomas L. Powers** advises that he is still living in Fargo, N.D. He is connected with the Powers Motor Hotel. He states "Best regards to my old classmates and they must be old." Some of us have a right to claim "equal time" to reply to that description of us. At our 50th reunion of the class there were a number of spry and lively members.

Frederick O. A. Almquist visited Greece last July with his daughter, son-in-law and family. Although the Cypress situation occurred in the middle of his visit, it did not interfere with the pleasures and wonders of his trip — during which he toured the entire country. . . . **Bob H. Henderson** continues to travel extensively. He keeps busy with local community activities including the Red Cross and his church affairs. More power to you, Bob — keep it up! He has a family of five grandchildren, of whom the oldest is a high-school senior. He admits that his family keeps him young. (Thomas L. Powers please note this statement.) . . . In a recent letter from **Howard F. Russell** he tells us that his term as Wing Commander of the Silver Wings of World War One ended with the May meeting. As an avocation he substituted for a "Ham" radio operator in Gun City and talked with his own station on Pitcairn Island in the South Pacific. He still loves to fly and made visits to relatives and friends

on Cape Cod, in Massachusetts and New Hampshire. The Silver Wings were invited to attend the ceremony when President Ford accepted delivery of the first new fighter plane, the F-15 Eagle, at the Luke Air Force Base, and occupied seats midway between the "Air Force One" and the President's plane. Howard took a number of pictures on this occasion. He has made a number of flights within the boundaries of Arizona and never tires of seeing the mountains and desert. His roses are still beautiful but the oranges are not yet ripe.

A letter from **Kenneth G. Merriam** of Worcester, Mass., states that he has many photographs (postcard size) of the R.O.T.C. camp activities in June and July, 1922. He also states that he would be glad to mail them to **Tom Rounds** for possible use at future class reunions. (Sure, Ken go ahead. These would be interesting to surviving R.O.T.C. cadets and others.) . . . A Christmas Letter from **Arthur R. Stuckey** of Tucson, Ariz., reports that his wife, Helen, has been having a long siege of physical difficulty requiring extended hospital treatment. It is gratifying to report that there is continual improvement and that Helen walks with walker or quad cane and transfers to wheelchair or car and the outlook for her complete recovery is bright.

Occasionally **Sam Williams** of peaceful and serene Enfield, N.H., writes me letters with choice descriptions and remarks. (I roomed with him for three years so he is "off-hand" with me.) In a long letter at the end of the year, he said: "We were invited to join a local family to help them put away their turkey. Our host was born here. His father ran the movie theatre. We don't have one of those now just like a lot of other things we don't have now such as a doctor, a dentist, a barber, etc. This is all a result of that gas guzzling machine that pollutes the air and kills but we can't exist — or won't — without it — even though it makes the Agerabs wealthy!" Elsewhere in the same letter, Sam gave the following description: "The open space in front of the house has a fair slope. It makes good coasting for the younger children. Some come and ask if they can slide there which is nice but a bit of a nuisance answering knocks at the back door. Perhaps I'll tell them that they needn't ask but I hate to interfere with their recognition of some one else's property. (That's rather rare now-a-days!) They use about everything to slide on but a sled. A piece of plastic seems preferred. We used to slide in the road where the snow was packed by a big horse-drawn four-roller for sleighing. You could hitch a ride back up the hill on the rear of a sleigh or empty logging sleds. Loads of logs still go by on trucks of course. They go loaded in both directions which seems like there's need for planning somewhere. Free market effect, I guess." — **James A. Pennypacker** Assistant Secretary, Long Hill Road, Essex, Conn. 06426

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Again these notes will lack the scintillating Ambach pen since, while Ethel is home from the hospital and much improved, Russ can still do with a lift from his co-secretary.

Letters and Christmas card notes to the **Paul Cardinals**, many of them congratulatory on Paul's handling and reporting of our grand 50th, have provided a wealth of ma-

terial for this set of notes. — From **Curly Fletcher**: "Ruth and I have read and reread your delightful report on the finest 50th Reunion ever. It brings back vividly the many happy events of that most pleasant occasion and we shall keep it and the group picture to cheer us up whenever a tonic is needed. After the reunion we spent about a month at our cottage in Maine, with friends in Pittsburgh, and with our daughter in Missouri. Since the middle of July we have been here at home in Florida having a nice quiet time." ... From the **Paul Millers**: "This is a long overdue note to tell you what a perfectly wonderful reunion you and the committee arranged. We think everyone had a marvelous time ... We have seen the Harveys only once since our return. They plan a cruise at Christmas. It is remarkable Gordon has recovered so well, but both he and Claire worked hard at the therapy." ... From the **Gordon Harveys**: "Our holiday wishes are going out early as we are going on a cruise about the middle of December. Gordon is doing pretty well — enjoying his poker and bridge clubs as well as the sun pool." ... From the **Frank Manleys**: "It was a fine 50th — From January 22 to April 8 we plan on a 75 day cruise visiting 29 ports from the Amazon to the Black Sea." ... The **Bill MacCallums** who are planning to attend the Florida Fiesta said: "We are just back from a three-month cruise-trip to New Zealand, Australia, and the Pacific Islands, and expect to be at Lauderdale by the Sea for a couple of months starting January 16." ... From the **Walt Bagbys**: "Still thinking and talking about that great reunion ... Walter played a qualifying round for the winter tournament with an 89. Any time he breaks 90 he's happy." Great going at our age Walt! ... The **Phil Bateses** wrote: "This year we enjoyed the 50th at M.I.T. Phil has continued his job as editor and his advisory efforts involving professional contacts here and in other cities for meetings. Jacky continues her treasurer's bit for her Children's Hospital Auxiliary and helping the Wellesley Club raise funds through pecan sales and its book "Wellesley After-Images," a collection of essays by famous alumnae."

Other letters praising the reunion came from the **Pret Littlefields**, the **George Knights**, the **Diffy Davols**, and the **Phil Blanchards** who plan to attend the Florida Fiesta. We also heard from those who were unable to attend the reunion. From Mrs. Betty Crafts: "Thought of you during the reunion. I was in London." ... From Mrs. Helen Wininger: "I'm sorry I had to miss the 50th reunion. From all reports it was quite an affair. You certainly head a busy, interesting life — I love reading about it. I didn't know you were married the same month and year Ed and I were." ... From **Sox Kinsey**: "Doing more I.E.S.C. (International Executive Service Corps) projects overseas." ... And finally a long quote from a letter from **Emilo del Prado** in the Philippines: "In spite of the fact that I am in perfect health and appear younger than what my age (74) records, I have two handicaps. I cannot travel by boat because I get terribly seasick, and have what I call flight-phobia because of high altitude. So I am destined to miss all class reunions to come. I have two daughters resident in Florida, one with five children, and the other with seven, two of whom are now studying in college there. Here in the Philippines we do not have winters nor springs, so we do not have any

problem of heating our homes. However, the oil crisis is hitting industry and transportation. My electric bill went up ten times during the last two years. Prices of food stuffs went up, even taxes. Since the imposition of martial law life remains as usual, the same, or I should say — for the better. Law-abiding citizens have nothing to fear, but law-breakers are given swift justice for crimes which took place mostly during the dark days of pre-martial law."

Letters and notes reaching **Russ Ambach** through various other channels contain the following news: **Ted Taylor**, who was reported in last month's notes as looking from the Pocona Lake Preserve: "My life is quite relaxed here in the woods; though of the 132 families that belong, a number show up on weekends, and three families live here all year. Up until last summer I served on the board of the Preserve, but now, I am off all active organization meetings. As I don't see any of our class except at reunions I am hopeful most of the group will be back again in '79." ... **Bill Sturdy** reports that after, but not as a result of, our 50th he went to the Cape Cod Hospital for sixteen days to recover from a coronary; he is now (as of December 20) in partially good condition but has to watch out what he eats and does. Very best wishes to my old viola partner in the Tech Show Orchestra! ... **Tien A. Koe** writes: "On account of the distance involved, sorry to have missed the reunion. We came to Hawaii a little more than two years ago and have been enjoying the mild climate and fine scenery. It is quite warm in the sun but nature came to the rescue by providing a magnificent shade tree called the Monkey Pod Tree, and keeping the invigorating trade wind blowing almost all the time." ... **Marguerite and Malcolm Finley** are taking a two week trip through the Galapagos Islands during January 1975 and regret not having checked for M.I.T. alumni in Quito and Bogota which they will have visited en route. ... **Everett Elting** is reported by the International Executive Service Corps to have left immediately after our 50th to serve as director of operations for I.E.S.C. in Ghana. There he has a group of six experts advising the University of Ghana, the State Hotels Corp., Ghana Airways, the National Investment Bank, the Ghana Tourist Board, and the West African Examination Council — all government controlled entities. ... Capt. and Mrs. **Chester V. Jones** were interested participants in a visit of the M.I.T. Club of Oregon to the Portland General Electric Company's Trojan Nuclear Power Plant on the Columbia River near Portland. President of the club and vice president of Portland G.E. is Bill Carey, M.I.T. '50. ... **Reginald B. Miner** is enjoying a quiet life in Wellesley, Mass. after 36 years with the John Hancock Life Insurance Co. followed by post-retirement service for seven years as a trustee of the Brookline Savings Bank.

We regret to note the deaths of two classmates, that of Brigadier General **Vennard Wilson** of Menlo Park, Calif. on June 20, 1974; and of **S. Hallock Dupont** of Wilmington, Del., on October 3, 1974. The class' sympathy is sincerely extended to their families. We have no further information except that Gen. Wilson was with the Army Ordinance Unit while a M.I.T., and Hal Dupont was in course IX-A, a member of Phi Gamma Delta fraternity, and associated with the E.I. Dupont de Nemours company.

By the time these notes are published, the Feb. 28-March 1 Florida Fiesta will be a matter of history after having been beautifully organized, publicized, and hosted by the **Clint Conways**. At this writing **Luis Ferre** and the **Al Roigs** are planning to come from Puerto Rico, the **Cornishes** from Mexico, at least three couples from New England, and many from Florida. The notes in the May issue should contain a full account of what actually *did* happen! — **Russell W. Ambach**, Secretary, 216 St. Paul St., Brookline, Mass. 02146; Herbert R. Stewart, Co-Secretary, 8 Pilgrim Rd., Waban, Mass. 02168

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A few days ago I attended a meeting of the Reunion Committee presided over by **Jim Howard** and **Ed Kussmaul**. Things are going along splendidly and probably before you read this you will have a notice furnishing you with a great many of the details of the plans for the big affair. It sounds to me that a good time will be enjoyed by all with plenty of things to do, but still opportunity to renew old friendships. Jim and Ed really are working to see that we will have a bangup time and I hope to see you there. ... **Doc Foster** has received a certificate indicating that after 50 years he has become a Legion of Honor member of the American Institute of Mining, Metallurgical and Petroleum Engineers. Two other class members have also received the same honor, **Bill Brown** of Maine and **Jesse Maury** of Maryland. Doc has also been celebrating his 50 years as a member of the Masons.

I seem to have accumulated a few items worthy of note, so here goes. **Anthony Tsongas** writes that for their winter vacation they are driving to Mexico, Guadalajara and Azatlán; from there up the coast of the Gulf of California to Tucson, Ariz. and back to Lewiston, N.Y. by a generally southern route. ... **Archer Nickerson** observes that he is feeling akin to Alice in her dream in "Through the Looking Glass" when she became a pawn in a chess game and had to run like "Hell" to stay in the same place. ... **George G. West** apparently has just undergone surgery. ... **Israel Goldberg** has just retired after 35 years with Stone & Webster. ... **Kenneth A. Lucas** has retired from regular employment as of January 1, 1973. He is still doing some consulting and survey work on the side and teaching a course at Northeastern University. He is also a director of the School of Survey which conducts correspondence courses in the survey field. This fall he was named Surveyor of the Year by the Massachusetts Association of Land Surveyors and Civil Engineers. ... **Roger Ward** sounds as if he will not make the reunion. He is leaving New York for Sydney, Australia, and then to Singapore. For three or four years he has been serving as the foreign service representative of the Florida Institute of Technology. It is the first place ever to offer a master's degree in aerospace science. As a result of his foreign traveling Roger has recruited two students from Saudi Arabia and one each from Bangkok and Hong Kong. He wants to be remembered to all of us since he will be missing in June.

Ed Zetterberg expects to be with us in June. I note that according to records that I have Ed has attended all major reunions.

Gjon Mili Photographs "Catch You Alive"

"Ideally . . . freezing the fleeting, the momentary, into a viable posture is what photography is most about," says Gjon Mili, '27.

"A photograph need not invite reflection so much as create a shock and arouse the viewer to the strangeness of the passage. It can illuminate the truth of a gesture, make visual a musician making music, capture the wonder of a child reaching for a soap bubble, give life to stone."

"Man and Movement," a Gjon Mili photographic exhibition at the Washburn Gallery in Boston's Museum of Science (until March 31), embodies this philosophy. And it is magnificent.

Picasso drawing with light, character sketches of the famous (and anonymous), children, theater, Watergate. A strobe photography analysis of the walking movement of an artificial leg (reflectors were attached to hip, knee, and ankle.) Professor Harold E. Edgerton and his student as they photograph the famous milk drop. Line prints, like drawings — white on black, black on white. Four decades of experimental and editorial photography, always catching the

fleeting second.

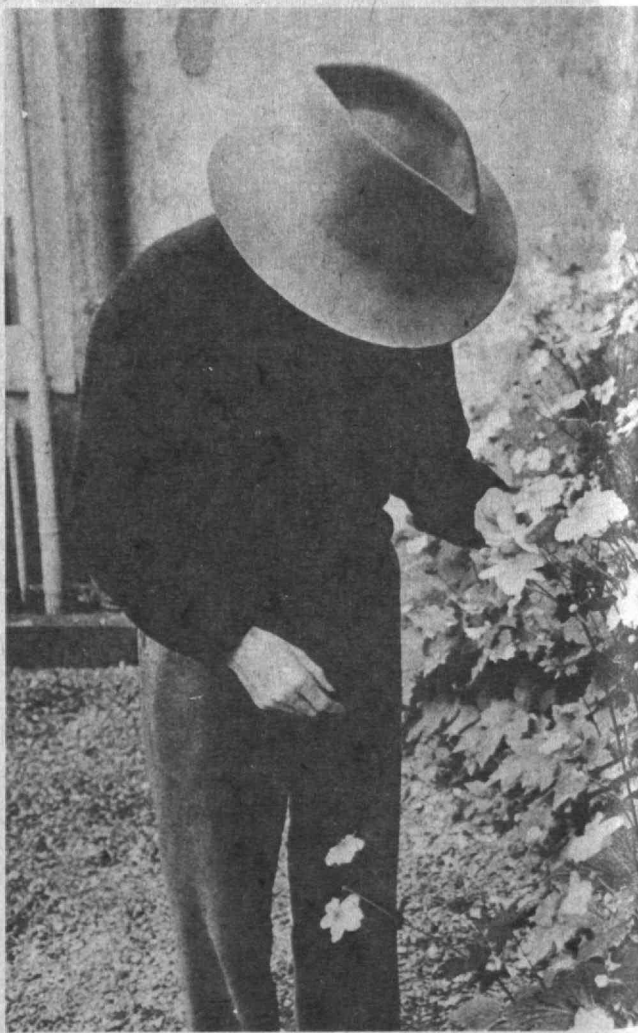
Fifty-two years ago Mr. Mili left southern Romania and landed on Boston shores, to spend eight months at English High and four years at M.I.T. He says the scientific, experimental part of his pictures comes from his studies at M.I.T. The second part, which he calls "the expression of humanism," comes from the happy accident, a long time ago, of meeting a man named Harold Edgerton. "He took me to the cinema," said Mr. Mili, "and told me that here at last was a new art — this capacity to change the value of time, to create an image chemically by mind and feeling. It was the beginning of my interest in art. (If I had my way in life, I would be someone in the movies — but life doesn't operate in a straight line.)"

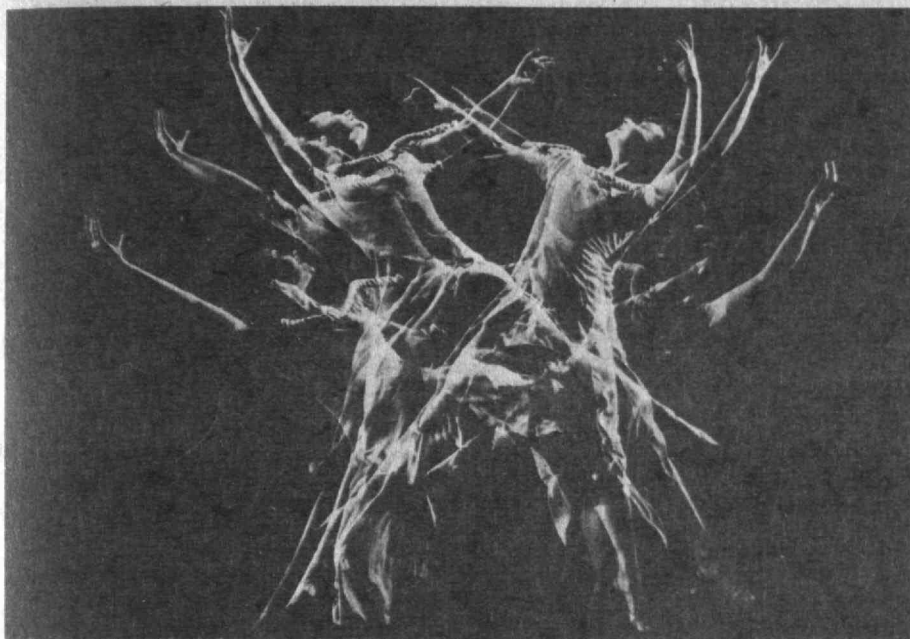
Research in lighting for Westinghouse and lecturing in photography followed graduation. Then in 1937 Professor Edgerton asked Gjon what he could do with strobe lighting. Mr. Mili remembers his answer — and the beginning of a long involvement with high-speed photography: "Give me ten times the light, and I will quit working for Westinghouse. (I was thinking of *Life*

magazine already.) I got five-fold the light. Then a higher speed film was developed, and I was in business. My interest was in making sharp pictures of movement — and I thought *Life* would also be interested. Now, after 35 years of sharp photos of movement, I'm doing the opposite!"

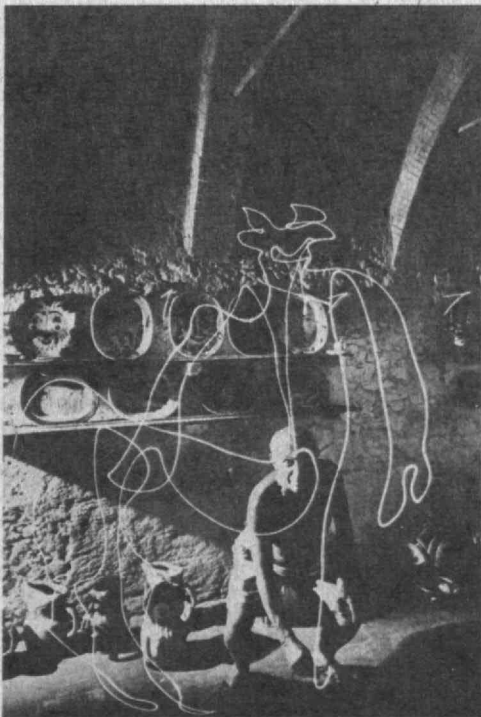
A note by Jean Paul Sartre on Gjon Mili to introduce his 1946 exhibition of photographs in Paris seems a timeless description: "Before I met Mili I had been familiar only with those thin-blooded photographers who take pictures out of a kind of resentment, as one kills something. Mili is without resentment, he likes everything: eating, drinking, dancing. He is happy. He does not want to kill you — far worse, he wants to catch you alive . . . in his photograph you keep on fighting with yourself, like a fish in a net. . . ."

"For him there are as many ways of being photographed as there are people. If he makes you a part of his collection, he will not only pin you, all alive and struggling, to his specimen board, but, beyond that, he will have observed you, he will know you through and through." — M.L.





At the opening of the "Man and Movement" exhibit of Gjon Mili photographs at the Washburn Gallery in Boston's Museum of Science are Bradford Washburn, the museum director, Dr. Harold Edgerton, and Gjon Mili (photo at left, by Richard F. Reihl). Some of the photographs in the exhibition: "Dotible Leap," Ethel Butler, 1941 (above); Senator Sam Ervin, at Watergate Hearings (below, left); Picasso Drawing with Light "The Centaur," 1949 (below); "Saturday Night at Cafe Society Downtown," 1943 (facing page, left); Sean O'Casey in the Garden, 1953 (facing page, right).



He has a grandson in the class of 1975. Ed is not too well but keeps up many activities including local school board, fishing and being a lapidarist. He has four children, 11 grandchildren and one great-grandchild. . . . **Bertha Rozenberg** says that she and her three dogs are still vegetating in Palm Springs. . . . **Alan Crowell** writes that he has enjoyed almost two years of retirement. He is affiliated with the M.I.T. Club of Sarasota where he not only encounters club members but many visitors from the north, particularly New England.

I received a letter from **Sam Spiker** asking why I did not include something about my trip to the Canadian Rockies last year. More about that later. First it reminded me about the work Sam and **Chink Drew** still have to do on the class gift. I.R. is my definition for this year which makes it even more difficult. I.R. is not Internal Revenue but Inflation-Recession. Most of us have lived through this before and survived so let's see if we can do a little more. Three letter slogans are popular these days and I am going to try my hand at one: C.U.M. which can mean two things Come to The Reunion or Cough-Up-More. My wife and I enjoyed our Canadian trip. We are very fond of western Canada. Perhaps I am a little prejudiced being a native of Canada, but my wife is a Damn Yankee and she likes it too. I am not too much impressed with the Maritimes but what interests me in Canada from Toronto-Montreal westward is the cleanliness of the cities. One does not get rid of a cigarette unless there is a receptacle handy and as for papers, none at all. A lot different from things around Harvard Square. We had good weather, hot at times. We went out and back part of the way by train. My wife and I, putting together pieces of various trips have crossed Canada by rail from the Pacific to the Atlantic.

I am sorry to have to report the passing of **R. Kirk Askew** of Pennsylvania on March 30, 1974 and of **Hugh M. Henry** of Altamonta Springs, Fla. on Nov. 7, 1974. — **E. Willard Gardiner**, Secretary, 53 Foster St., Cambridge, Mass. 02138

26

Ruth tells me that the last few issues of my notes have been colorless and I too have been aware of it when reporting without the usual ad lib. There's a reason and I may as well explain. I've backed into an assignment with the Alumni Fund that not only takes a great deal of time but the amount of writing, especially long hand letters, has used up that kind of energy I've always reserved for class notes. A couple of years ago at an Alumni Council meeting I casually asked Fred Lehman if there was a committee for the Sailing Pavilion. A few days later I learned that one had just been created and I was it. I started with visits to the Sailing Pavilion and by travelling with the team to regattas. Quietly I began to be introduced as "the alumnus who was going to raise money to modernize and expand the Pavilion and to replace the aging fleet." How naive can an old member of the class of 1926 get? But so long as you will call it naivete and not senility I'll smile. By last spring the M.I.T. planners decided to "let us" go ahead with the project and we were off and running. To run we really had to have a committee and then a brochure. It

always makes life easier in assembling a committee to be able to refer to renowned individuals as being members so you can start big. Classmate **Austin Kelly** has been a member of the New York Yacht Club for a long time and as you would expect knows all of the members. Austin also will do anything to help another '26 man so before I could catch my breath Austin had lined up the world's number one yacht designer, Olin Stephens, '30, world famous yachtsman, Summer D. "Huey" Long, '47, and Daniel D. Strohmeir, '34, who has raced ten times in the famed Bermuda Race and is listed among the winners. With this as a start a committee was put together which, if you except the chairman, looks like "who's-who" in U.S. yachting. Of course, after some arm twisting, Austin became a member and another '26 man **Pete Doelger** also graces the list of 20 members. The "pro's" at M.I.T. then helped us put together a brochure which is a masterpiece — "M.I.T. pioneered sailing instruction and racing at the collegiate level in the thirties. The program and facilities established were the first at any college or university and were the model for others across the country. In its 40 year history, the Sailing Pavilion remains unchanged, and the fleet has been replaced only once. The second fleet is now 21 years old and urgently needs replacement — the cost of renovation and expansion of the Pavilion and replacing the fleet is estimated at \$211,800." These words are from the prologue of the brochure and in mid January we have reached the half way mark of \$106,000! Jack Wood, '17, was the first and only sailing master until he retired a few years ago. In honor of Jack, his classmates got our program nicely launched with a pledge of \$25,000 and loyal sailing alumni have been backing us ever since. If any of our readers '26 or from other classes would like a copy of this fine brochure just drop us a card at the Pigeon Cove address below and we will speed it to you. You may just wish to support this worthy program especially when you learn that all gifts toward the Sailing Pavilion are considered Alumni Fund contributions and also count toward the Class Gift.

A note arrived this morning from **Eben Haskell** with a clipping from the January 15 issue of *Electrical World*, telling of the death of **A. Sidney Brookes**. "A. Sidney Brookes, pioneer in U.H.F. underground transmission, is dead at 71. While with Public Service E&G, he, along with Herman Halperin and the late Clem Schifreen, was instrumental in starting the original 345-kv cable research at Cornell. In addition, Brookes, along with Schifreen, A. F. Corry of Boston Edison, and others, was instrumental in instigating the underground research and development program that is now part of E.P.R.I. He was a past president of Cigre's International Cable Committee, a fellow and life member of I.E.E.E., and past chairman of E.P.R.I.'s Underground Transmission Steering Committee." Eben says, "I hadn't seen Sid for years — but his passing brought to mind that in the spring of 1926, he and I went down to visit Public Service of New Jersey, and were interviewed. He obviously accepted — as did **Earl McMahon**, another classmate. I took one look at the Jersey meadows — and wanted no part of it! Funny how things affect one's decisions."

In the same mail information came from Alumni Records that **Edward N. Dingley**

had died on January 4 in St. Petersburg, Fla. and **Emerson W. Eddy's** wife dropped us a note telling of "Wick's" passing in late November. For the class your secretary extends sincere sympathy to the families of these three classmates.

We have several "back of the alumni fund envelope" notes from classmates but will use only one this month because of its particular reference to Sid Brookes. The envelope is not signed but we believe it to be written by **Peter Bellaschi**. We quote: "Sid (A.S.) Brookes, '26-VI, and Peter (P.L.) Bellaschi, '26-VI, both attended the biennial conference of CIGRE (International Conference of Large High Tension Electric Systems) in Paris August 21-29, 1974. Bellaschi has been a regular member and attending CIGRE since 1937 — (ancien eleve) — and Brookes equally strong supporter. Under consideration at present — more so with the energy crisis on our hands — are the electric power transmission voltages of 1200 kv."

We usually are not writing classnotes at 9:30 p.m. on the night before they are due but this time it happened so we can say Goodnight and Cherio! — **George Warren Smith**, Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

27

Les Woolfenden has been elected president of the Board of Directors of the Forest Hills Public Project Corp. in Paducah, Ky., where he has made his home for some years now. This is a 500-unit public housing project, and directors serve without compensation. Reports are that the project is in much better shape than most. All units have been rehabilitated, occupancy is running over 90%, with a waiting list; the project has been making payments to the city in lieu of taxes; and it has been self-supporting, paying its expenses and debt service out of revenues. Les was regional manager for G.A.F. Corp. before his recent retirement, after 42 years with that company.

One of the most peripatetic members of our class, **Al Buffum**, finds time between trips to be active in civic organizations. He is president of the Elkhart (Ind.) Redevelopment Commission and of the Advisory Council of the Elkhart Area Career Center. A year ago, we recorded some of his more recent travels in these notes. Since then, he took a fishing trip in June catching Pacific Salmon near Kitimat, British Columbia, and later went on a charting expedition to locate fishing areas for Arctic char and lake trout off Victoria Island, near the Magnetic Pole and the Arctic Ocean. "We had three float planes for six fishermen," he writes, "and it was a fantastic trip."

In last year's March-April notes, I recorded that **George Fexy** had retired for the second time at the end of 1973. He now tells me that the official date was February, 1974. "I envision a serene retirement," he says. "No pressures, no conflicts, no conferences, no arguments with contractors or unions, no Washington trips to argue before the Engineering Board of Contract Appeals — just play handball." Here's hoping it's turning out just as he expected.

Middleton Perry retired at the end of 1973 from Black & Veatch, Consulting Engineers in Kansas City, after nearly 38 years as an electrical engineer with the firm. . . . **Moe**

Smith is still cultivating his orchids and keeping up his other hobbies in the Virgin Islands. . . . I have notes this month from two classmates who, like your secretary, belong to more than one alumni association. **Charlie Pope** is looking forward to the 50th Reunion, but meanwhile he is wondering whether he can get one of the red jackets in advance, to use at the Stanford '76 reunion. (I'll try to find out for him.) He did make the 40th Reunion at Bald Peak. He is enjoying retirement to the full, he reports, and makes annual charter trips (from San Francisco) to Europe.

George Jenkins, who is Bowdoin '28 as well as M.I.T. '27, saw my recent note on Stonehenge and says that he, too, was tremendously impressed. His family came from England (Yorkshire), and he has cousins there by the dozens whom he has visited several times in the past few years. He still corresponds with ten of his English cousins.

George conveys the sad news of the death of **Albert W. Nevers** in Daytona Beach, Fla., on July 10, 1974. Abbie had suffered a massive coronary in February. Since retiring as a coal mine operator some years ago, he had spent about half of each year as a radio operator on ships bound for the Far East, Europe, and South America. His interest in "ham" radio dated back to his high school days in Winthrop, Mass. He is survived by his wife, Frances, a son and daughter, and several grandchildren.

There are three other deaths to report this month. **Ole F. Christiansen** died in Englewood, Fla., on July 26, 1974. We have not heard from him in recent years; at one time, he was advertising manager of the Reece Corp. in the Boston area. . . . **John A. Keary** died at South Yarmouth, Mass., on April 6, 1974. . . . **Rene Paine**, who had been a trustee in Boston before moving to Florida a number of years ago, passed away in Fort Lauderdale last September 1.

To close on an upbeat — **Gjon Mill**, who has made an international reputation as photographer, author, and experimenter in stroboscopic photography since graduating with our class, has been having an exhibit at the Washburn Gallery of Boston's Museum of Science — a 50-year retrospective of his work. The exhibit, titled "Man and Movement," is scheduled to close March 31; by the time these notes appear, it will be too late to catch it unless it is extended. — **Joseph H. Melhado**, Secretary, 24 Rodney Road, Scarsdale, N.Y. 10583.

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To the many classmates who sent in holiday greetings, your officers take this opportunity to express thanks and deep appreciation. It is heartwarming to hear from those who correspond with some frequency and we are always delighted to have news of or from all classmates. Some of the cards carried brief news notes which we are happy to relay to you: Anne and **George Palo** expect to tour New England next June as a change from visiting old England. This will also provide them the opportunity to attend Alumni Day at the Institute. . . . Jo and **Fritz Rutherford** still exclaim over their enjoyment of the 45th Reunion and are eagerly looking forward to the 50th. They are very happy with living in Frogmore, S.C. and have lots of enthusiasm for life. . . . **Bob Larson**, in spite of eye

surgery, managed to write a letter from his hospital bed to **Jim Donovan**. In November Bob and wife Kathleen had a pleasant surprise visit by Barbara and **Earl Crawford**. Bob has also been in correspondence with **Dick Rubin** and with **Newt Foster**. . . . In a note of his own, Newt told of his six weeks visit in England last summer. He and Olive were fortunate in having friends to stay with in Sheffield and with whom they shared a common interest in oriental rugs. Later in the summer they all attended the Third Annual Oriental Rug Convention in Washington, D.C.

Edith and **Ray Wofford**, reporting from San Marcos in California, are still enjoying golf three or four times a week (Ray's handicap now up to 11) in spite of age and some ailments. . . . Peggy and **George Mangurian** spent four weeks in Europe last summer. They flew to Vienna, then drove into Italy across the Dolomites Alps to Ravenna, Florence, Siena and finally to Rome for eight days. Prior to the trip George had contacted **Vic Decorte** for hotel and restaurant recommendations. This helped greatly. . . . We have a card from Vic and Alice in Florida that tells us they had a visit from Ana and **Mariano Contreras** up from Caracas, Venezuela.

A letter from Mary and **Max Marshall** encloses a color photograph showing a view of mountainous Montana country as seen from the roof of their home. They have good reason to enjoy the location. . . . Anne and **Walter Hildick** are pleased that their daughter Patricia, her husband, and two children have now moved to Worcester, Mass. so they will all be in the same city. The new medical center there was one attraction — Patricia is a pediatrician and husband Bob a neurologist. However, Walter suspects another motive was to keep the two old folks busy, interested and away from any danger of withering on the vine. . . . Martha (Mrs. **Donald Fraser**) wrote that her daughter Suzanne had just finished her masters work in library science. . . . Alice and **Slim Maeser** said they were going to Bermuda at the end of the year for a week of stay. Slim still plays golf every day that is pleasant. Alice does volunteer work for the elderly. . . . **Nap LaCroix** is still doing some independent consulting work. In view of present pressing national needs, Nap would like to put his extensive experience to work toward improving fuel/energy availability and fuel use economy.

Gladys and **Bill Phillips** are looking forward to the next reunion. Bill says they shared a hospital room last summer! . . . Helen (Mrs. **John Stack**) asked that she be remembered to all '28ers. . . . In their annual news letter Betty and **Dud Smith** reported they were especially impressed when they traveled in India. The beauty they saw there greatly outweighed that which was unattractive. . . . Adrienne and **Art Josephs** are enthusiastic about the way their area at Duluth, Minn., is developing into a beautiful tourist attraction. They are particularly pleased with its growing cultural center.

Fitch Briggs said he was increasing his Fund pledge this year and that the amount would be matched by his former employer. Last June Fitch and Dorothy enjoyed a trip to Hawaii and a tour of the islands. . . . **George Chatfield** enclosed a note to Jim along with his check. Each weekend George broadcasts an editorial ten times over his radio station WFGH (960 KC) and

WFMP (FM 104.5) . . . Writing from Greece, **John Houpis** also said he was increasing his support to the Class Gift effort and that he would help further by contacting others. Any classmate traveling in Greece is invited by John to taste of Grecian hospitality. — **Walter J. Smith**, Secretary, 37 Dix Street, Winchester, Mass. 01890

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George L. McKenna has sent a note as follows: "Thanks for the birthday card. It is nice to get some mail from M.I.T. which is not a request for money. We came to Florida in mid 1967 heading toward retirement, but I am still working. I spent three years as personnel director for the city of Nero Beach, then retired. It turned out to be a short retirement as I was asked the following month to set up a personnel system for the county. As a result I am now assistant county administrator. After leaving M.I.T. I was with N.E. Telephone for 11 years, R.C.A. ten years, vice president in charge of sales for Toledo Seale Co. for six years and sales engineering in electronic companies until 1967. I was in your area two months ago. My home town was Portsmouth, N.H."

Lawrence S. Newman has retired and spends his summers in Maine and winters in Florida, the dream of most retirees. He and his wife Eleanor enjoy square dancing which they find very stimulating both mentally and physically. "In March", the note continues, "we expect to take a two week trip to Mexico which will include a train ride through the Copper Canyon. If the gasoline supply does not get too tight, we hope to do some traveling around the U.S. and Canada in our motor home. If we want to do it at all, it would have to be soon. Time marches on!"

. . . I have a New Year's card from **Jarvis M. Hazard** thanking me for the birthday card from the class of 1929, and wishing a healthy year to all his friends. . . . A note from **William J. Degnen** reads: "Enjoyed a three month auto tour of the northwest and Canada with intermediate stop-overs at various points visiting fellow retirees and scenes of former refinery projects with which I was associated while working for the M. W. Kellogg Co. as project manager, for 40 years. I like the way you handle the secretarial job. Thanks for the birthday card."

G. Grier Kirkpatrick has retired from a family-owned business dealing in building construction, except for a little consultation work. He and his wife Ellen lead a quiet life in Florida and enjoy participating in many activities including civic and church affairs and a little golf. . . . **Donald L. Hibbard** has retired and moved from Colorado to New Hampshire to live, and is getting adjusted to both changes. . . . **Frank Mead** and his wife Mary are spending their winter vacation in their familiar haunts at No. Port Charlotte, Fla. "Mary and I have joined the country club," he continues, "and have joined the Men's and Women's Clubs, which means organized golf tournaments, bridge parties and other social functions. My golf was coming along fairly well until I got a pinched nerve in back of my neck — which is a real 'pain in the neck.' I am getting traction and heat treatment, which will enable me to get back to my golf within a week (I hope). We plan to stop over at Fort Lauderdale to see you and **Hugh Hamilton** and Helen on our way home."

Phil W. Sayles writes: "Your requests for class news got mixed up with requests for money from the Salvation Army, Boy Scouts, Nurses Aid, the Republican Club, Channel 13, Audubon Society, M.I.T., etc., which accounts for the delay in answering. I am enclosing the 'Sayles Roundup — Christmas 1974' which will shed some light on our family activities which will help you. In the meantime, have a nice Christmas and regards to all." "Sayles Roundup" shows that a grandson, John Whitman Sayles was born on July 7, 1974 which pleased everyone including newly-born's sister, Jennifer. Phil and his wife Milly visited their daughter Meredith in Maransart, Belgium, a picturesque little country village, 15 miles south of Brussels, where she is editing an English language newspaper, the *Brussels Times*, covering international events. They spent six weeks in April and May traveling in France, Belgium and the Netherlands — all very interesting. Phil is still golfing, mowing, planting, weeding, etc. In regard to golf, he says "I swing just as hard, but the ball does not go as far. Short game, not too bad — except on off days." Milly enjoys Garden Club, Audubon Society, growing flowers, shrubs, tomatoes and many house plants. In between they are roaming around the country visiting Connecticut, Massachusetts, Vermont, New York State, seeing new sights. They wish health and happiness in 1975 to all.

A newspaper clipping sent by **Wally Gale** announced the death of **John B. Osborn** on January 9, with a statement that "Jack Osborn was one of the shining lights of the class of 1929 — we shall miss him and his leadership towards our 50th Reunion goal." Jack was associated with Forbes Lithograph Manufacturing Co. for many years and at the time of his retirement a few years ago, he was president and chairman of the board. He was president of the National Association of Printers and Lithographers, an officer and director of Gravure Technological Ass'n., president of the Printing Industries of America; director of the Associated Industries of Massachusetts and a pioneer in gravure printing on film. He lived in Chestnut Hill, Newton, was an alderman in Newton, a trustee of the Beaver Country Day School and of the Chelsea Hospital. At the time of his death, he was living in Hampton, N.H. He leaves his wife, Molly (Harding), and four daughters.

Received a letter from Dorothy Meissner as follows: "Greetings from snowy Winchester, and a happy, healthy 1975. Chatham seems far far away, doesn't it? I have something sad to report, Dot Powley died in September. As you remember, we sent a get well card to her signed by many of us at the reunion and subsequently **Ed Powley** had sent a letter of appreciation which appeared in the Oct/Nov Review. She is finally no longer suffering from her more than two year bout with a rare tissue disease called scleroderma. Both she and Ed were courageous and showed extraordinary strength through the entire ordeal. I feel proud to have them among my dearest friends. We saw Ed yesterday (December) at the home of his daughter Betsy, in Sudbury, where he was visiting for the holidays. He was showing his usual courage but he is naturally terribly lonely and lost without his ever charming Dot."

Nurses Der Marderosian passed away suddenly on December 7, 1974. He was

born in Armenia and came to this country at an early age, at the end of World War I to seek refuge and a new life from a war torn country enduring and striving miraculously all the barbaric atrocities committed by the Turks against the Christian minorities. Within five years after his arrival in this country, he mastered the English language and graduated from Rindge Tech Mid-High School in 1925 and M.I.T. in 1929. While an undergraduate, he was captain of the wrestling team. After graduation, he worked for 12 years for various firms as a chemical engineer, and in 1942, he took over the leadership and management of a family owned business dealing in oriental rugs. He is survived by his wife Siranoosh and four children. — **Karnig S. Dinjian**, Secretary, 6000 N. Ocean Blvd., Apt. 14-E, Fort Lauderdale, Fla. 33308

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Once again, we have a number of retirements to report. **Hal Spaans** retired in 1972 as director of engineering training at the Engineering Training Center of Bell Telephone Co. of Pennsylvania. However, he has continued as a training consultant in engineering economics for several independent telephone companies. He says that he and Marge are enjoying retirement and plan to stay in the eastern Pennsylvania area, but have some thought of wintering in Florida. Hal was a loaned executive to the United Fund for several years and is active in the Delaware Valley M.I.T. Alumni Club. Also he has given a course in engineering economics for the Engineers Club of Philadelphia for the past 11 years. He reports having seen **Hank Halberg** who is a U.S. government ground water expert based in Little Rock, Ark. . . . **Asa Shannon** has retired from the Army Corps of Engineers after 43 years of service. His retirement hobbies include antiques and chess. . . . **Myron Smith** retired in 1969 from his job as sales vice president of General Radio Co. in Concord, Mass. He is presently living in South Casco, Maine. . . . **Palmer Boggs** is now a professor emeritus but is continuing to teach one-half time and do consulting work. He doesn't say what he is emeritus from, but according to my records, as of 1971, he was a professor of architecture at the University of Arkansas.

Les Engler is enthusiastic about retirement. He writes: "It's wonderful. Golf, tennis, reading, some travel, just enough leisure time to enjoy. Fort Lauderdale in the winter, Vermont in the spring and fall." Les reports having seen **Tom O'Connor** last spring and that he "looks great." . . . **Gerry Morse** retired as vice president of Honeywell Inc. as of July 31, 1973, and the following day became president of the Council of Community Hospitals in Minneapolis. . . . **Bob Rypinski** reports an exceptionally active retirement program. He works as a volunteer for Recording For the Blind, recording technical textbooks for students who can't read for themselves. He is on the Los Angeles unit's board of directors and is active on several committees. In addition, he is secretary of the local section of the Audio Engineering Society which "takes a lot more time than I had thought." Also he is a director of his younger son's company, Very Important Products, which makes and sells a fine emulsion called "Armorall."

As previously reported in the notes, **Frank Hankins** ran into a problem with Parkinsonism some years ago. He now reports that he is feeling quite well again as the result of treatment with L-Dopa. Frank's family spent Christmas on a Georgia farm near Zebulon, 11 people in a six-room house. It was "pandominium but fun." . . . **Lawrence Gonzalez** reports that after three years of travelling he went back to work as a naval architect and still enjoys it as much as ever. . . . A brief note from **Allan McLennan** reports that in 1974 he spent 17 months in Panama "helping in new electrical developments." . . . **Saul Sigel** is technical director of Hampshire Designers in Manchester, N.H. His wife, Selma, is an M.D. who just resigned from the New Hampshire State Department of Public Health as Director of Maternal and Child Care to develop the Institute for Child Care and Development. . . . **Saul** reports that he recently saw **Morris Shaffer** and his wife and daughter. Morris has moved from his job as chairman of the Department of Microbiology at Tulane Medical School to the College of Medicine and Dentistry of New Jersey in Newark, where he is dean of the Graduate School of Biomedical Sciences. One intriguing aspect of his report was his statement that he "will be 65 in a few weeks." I didn't know there was anyone left in our class who could still say that he "will be" 65. Do we have any other classmates born after January 1, 1910? Please let me know.

We have at hand a notice concerning the death of **Norwood Kenney** on October 22, 1974, but unfortunately, no details are available. According to my records, he retired in 1969 as engineering vice president of Simplex Wire and Cable Co. At the time of his death he was living in Hingham, Mass. — **Gordon K. Lister**, Secretary, 530 Fifth Avenue, New York, N.Y. 10036

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A most welcome note has been received from **Frederic W. Nordsiek** telling of his retirement on December 31, 1974, and saying that he plans to settle at Chapel Hill, N.C., a selection made on the basis of researching the entire country. Best wishes, Fred, for a long and happy retirement. After graduation from Tech in 1931, Fred obtained his M.S. in biology from New York University in 1959 and Ph.D. in nutrition from Columbia University in 1961. In 1931, Fred worked as a research bacteriologist for the Borden Co. and later for the Sanoderm Co. until 1935. After that, he became executive secretary for the New York Diabetes Assoc.; associate nutrition director of the American Institute of Baking; assistant director, Research Service Department of Standard Brands; editorial associate of the *Technology Review*; assistant secretary of the research committee, American Cancer Society; editor of APHA manual; Scientific Associate Memorial Sloan-Kettering Cancer Center (later becoming vice president of their grants and fellowships); had several top management positions at St. Luke's Hospital Center; was adjunct professor of public health nutrition at Columbia University and finally associate research director of the Council for Tobacco Research. What a wonderful record. In addition, Fred has had 66 publications to date and lectured at the New York City Department of Health,



H. E. Marvill, '31

Columbia University, Syracuse University, New York University, Ohio State University and Teachers College.

Saw Hope and **Randy Binner** during the Christmas holidays. Both are looking well and still as interested as ever in curling. . . . **John Sherman** writes that he retired two and a half years ago. He and his wife were divorced in March and he sold his Long Island home and moved to Sedona, Ariz., where he is now building a house. . . . Another retiree, **John Parker** who retired last spring has been in Europe with headquarters in Copenhagen for the winter before returning to Chapel Hill in the spring.

. . . **Judson Miskimen** writes that he would like to hear from Fuel & Gas Engineering alumni of the classes of '29, '30 and '31. . . . Word from **George Humphreys** tells of his retirement from the Navy as Captain in 1963. After that George had five years as assistant to the president of Benrus Watch Co., then spent four years in the construction business and for the past one and a half years, he has been working as a broker in the real estate field. Two of his children are married and the other is still at home in Southport, Conn.

Bob McKenzie says that Jeanette and he continue to enjoy retirement in good health and, as the ancients advised, work and play, love and pray — all in moderation. . . . **Ben Mesick** writes that his daughter, Charlotte, is with the American Consulate in Hong Kong. Ben and his wife hope to visit her there in the spring. . . . **George Manter** is still struggling for the programs which he deems are necessary for our country: more healthy atmosphere in homes and offices; better communication between groups; facts instead of opinions. . . . **John MacBrayne, Jr.** is planning to retire from Union Camp Corp. on February 1 and move to Camden, Maine. . . . **Michael Kundrath** says he is still conducting an insurance and real estate office in Fairfield, Conn. His daughter, Diana, graduated from Boston University and is now proposal accountant with Perkin-Elmer in Norwalk, Conn. His son, Michael, has just obtained his doctorate in chemical engineering. . . . **Dave Buchanan** writes that he retired as assistant to senior vice president of Con Edison of N.Y. on August 1, 1974, and returned to New England immediately. He thinks Peterborough, N.H. is wonderful and is enjoying an active life of bowling, golfing, Historical Society, Garden Club and waiting for the skiing season.

Our deepest sympathy to General **Bob Fleming** who wrote: "My wife of 44 years, Eleanor, died suddenly June 4, 1974. We had just returned from France where she was — Madame la Generale — all over again did she lap up that cream. She held three decorations, one from our church, one from France, and the highest decoration of the Republic of Panama — all given for what

she had done for people. For nine of my last ten years on active duty, we were abroad in France and Panama and Eleanor became one of the most valuable servants America ever had. Hence the decorations." . . . **Art Bertollett** has now retired after 27 years of service as assistant chief system planning engineer for the Philadelphia Electric Co. and has relocated to Florida. Before that, he retired as a Brigadier General U.S.A.R.

Word from **Parker Dunn** tells of his forthcoming retirement after 45 years in the chemical and nuclear industries. He says that it has been real fun. . . . A recent publicity release tells of **Ed Marvill's** election as vice president — underwriting of Philadelphia Manufacturers Mutual Insurance Co. . . . A welcome letter from **Bill Stellrecht** says that he and his wife are planning a trip to the U.S.A. in 1976. He hopes to show her the places he knows around Boston. I expect to be in Stuttgart week after next and hope to see Bill. His business address is 7 Stuttgart 1, Uhlandstr. 14c. — **Edwin S. Worden**, Secretary, 35 Minute Man Hill, Westport, Conn. 06880; **Ben W. Steverman**, Assistant Secretary, 260 Morrison Dr., Pittsburgh, Penn. 15216; **John R. Swanton**, Assistant Secretary, 27 George St., Newton, Mass. 02158

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Manson Benedict, Institute Professor Emeritus and professor of nuclear engineering was awarded the John Fritz Medal for 1975 at the annual meeting of the American Institute of Chemical Engineers, December 2, in Washington, D.C. He received the medal for "his outstanding versatility and impressive breadth in the chemical and nuclear engineering fields, especially for his contributions to the gaseous diffusion process for separation of fissionable uranium isotopes." The award is made each year to recognize achievement in engineering and industry. Other Fritz Medallists from M.I.T. have included the late Willis R. Whitney, professor of chemistry, emeritus, in 1943; the late Vannevar Bush, former honorary chairman of the M.I.T. Corporation, in 1951; Crawford H. Greenewalt, a member of the corporation, in 1962; and Warren K. Lewis, professor of chemical engineering, emeritus, in 1966. . . . **Leroy V. Honsinger** has been recently elected president of the Society of Naval Architects and Marine Engineers for the term of 1975-1976. . . . **William A. Kirkpatrick** has presented to the Grand Valley State Colleges in western Michigan, a new 8-man racing shell, dedicated to the memory of Pat Manning. Bill who is now chairman of the board of the Kalamazoo Paper Box Corp., rowed in the lightweight crew under Manning's guidance in his undergraduate days. He has been a member of the Board of Control of Grand Valley State Colleges since August, 1960, and is an Honorary Secretary and a member of the M.I.T. Educational Council. He also co-founded the School of Paper Technology at Western Michigan University in Kalamazoo, and is past chairman of the school's Industry Advisory Board.

George B. Hoadley, head of the Department of Electrical Engineering at North Carolina State University for 20 years, retired last June 30. He had taught at the Institute and the Polytechnic Institute of Brooklyn prior to coming to the N.C.S.U. Dr. Hoad-

How the Name of a Famous M.I.T. Coach Comes to be on a Boat at Grand Valley Colleges

William A. Kirkpatrick, '32, has never forgotten his experiences on the Charles River rowing with the M.I.T. crew under the late Coach Pat Manning. But Kalamazoo, Mich., where Mr. Kirkpatrick is Chairman of the Kalamazoo Paper Box Corp., is a long way from the Charles River; so Mr. Kirkpatrick's enthusiasm for crew takes him instead to nearby (Allendale, Mich.) Grand Valley State Colleges.

It was there, this fall, that he gave

President Arend D. Lubbers of Grand Valley State Colleges a new eight-oared shell named in honor of Pat Manning; the presentation celebrated the tenth anniversary of rowing at Grand Valley, where Mr. Kirkpatrick has been a member of the Board of Control since August, 1960. Rowing was, in fact, the first intercollegiate varsity program offered at Grand Valley, the first of whose four coordinated colleges opened in 1963.



Late this month the "Pat Manning" will be rowed in pre-season practice sessions at Charleston, W. Va., by the varsity crew of Grand Valley State Colleges, Allendale, Mich. It is the gift to the Colleges of William A. Kirkpatrick, '32 (right), Chairman of the Board of the

Kalamazoo (Mich.) Paper Box Corp., named in honor of Mr. Kirkpatrick's crew coach at M.I.T. Also in the picture: President Arend D. Lubbers of Grand Valley State Colleges (next to Mr. Kirkpatrick); Paul Springer, Grand Valley coach; and the varsity crew.

ley is a Fellow of the Institute of Electrical and Electronic Engineers and is widely known for his educational and research contributions to the field of electrical engineering, particularly in the areas of network synthesis, electronic measurements, and computer programming. . . . **Sidney B. Jeffreys** still going strong, recently elected chairman of the board of the Jeffreys Engineering and Equipment Co., in addition to his other duties as chief executive officer and treasurer. . . . **Bettie and Don Whiston** enjoyed touring Scotland this past fall, according to their Christmas card. . . . **Ruth and Al Dietz** are thoroughly enjoying Honolulu, with Al handling a joint appointment as a Senior Fellow at the East-West Center and a visiting professor at the University of Hawaii and has just been asked to remain for another semester at the University. Al puts it in real perspective, "this 'retirement' suits us fine." In addition he has a roving workshop assignment to study housing for the East-West Center in Indonesia and the Philippines.

Suzanne Serrallach was a surprise Christmas visitor to Washington and assures us that she and John will be with us in Bermuda. . . . **Bill Pearce** phoned on his way thru to Florida via the auto-train, that he and Midge have made reservations to be with

the gang in Bermuda. . . . **Samuel E. Paul** notes in a recent report that he spent last July on a "busman's holiday" teaching nurse practitioners, senior medical students and family practice residents at the Community Hospital and Family Practice Center in Santa Rosa, Calif. A most pleasant experience according to Sam, and the added postscript, "come 1976 when I am 65 I might 'retire' into teaching."

Lots of retirement and semi-retirement news this month: **Robert L. Strong** advises that he is semi-retired, but still doing consulting work for Johnson & Higgins in Latin America where he spends about one month per year plus two months in Florida or other southern parts and the remainder of his time relaxing with golf, fishing, skiing etc. in Pennsylvania. . . . **Richard W. Berry** stays semi-active as a marine consultant in the steamship business and has no problem keeping busy in a new interest in the development of an air-freight vehicle and system concept, called International Husky, Inc. . . . **Jim Harper**, now fully retired from the Army and the U.S. Civil Service Commission is busily engaged in remodeling a second home on Chesapeake Bay as a rudimentary plumber, carpenter and electrician — I miss your supplementary reports, Jim. . . . **Theodore M. Lichtgarn** relates one

of the most enjoyable activities in his retirement is that of playing the violin in an amateur string quartet that meets weekly. . . . **Chip Chase** retired from Union Carbide last October after 35½ years service and intends to remain in Plainfield, N.J., where his work as president of the Library Board, an Elder of the Church and a three-day per week consulting arrangement will keep him busy. . . . **Gaynor H. Langsdorf** stays active working for the San Francisco Bay Area Alumni Club and the Educational Counselors plus the Special Gifts Committee.

Francis R. Russell since retiring from Esso Research & Engineering Co., in 1971, has been teaching electrical and chemical courses at a local Vocational-Technical School and announces that he expects to retire for good in a few months. . . . **J. Alan MacDonnell** retired from Dresser Industries in late 1973 and is enjoying life at Rye Beach, N.H., cold weather and all, doing some traveling, some golf and the myriad chores involved in breaking in a new home.

. . . **Katherine S. Burrows** retired from the welfare field in August, 1974, but remains active as the treasurer for the Holden Housing Authority and relaxes as "First Mate" on her husband's Tartan 27 which they keep moored at Wellfleet. . . . **Alwin B. Newton** has some problems convincing his wife that he is 'on retirement,' what with his consulting activities for the National Bureau of Standards and the National Science Foundation in the solar energy areas, along with Borg-Warner and his active participation as a member of the Governor's Committee on Energy for the State of Pennsylvania. . . . And I conclude this column with a very sad saga — **Arthur L. MacKusick**, in celebration of his 40th wedding anniversary, last September, took his wife Bettie on the auto-train for a trip to Montreal. Before leaving home he had an electronic intruder alarm system installed in his house. Alas and alack their car was robbed of most of their personal clothing in Rutland, Vt. Arthur's succinct comment, "C'est la Guerre!" — **John W. Flatley**, Secretary, 6652-32nd Street, N.W., Washington, D.C. 20015

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Please note that this report is written in early January! However, top billing goes to a lovely group of girls; wives who sent me the family Christmas cards, in the order of receipt: Ruth Timbie, Charalee Fossett, Ellie Cross, Doris Julian, Lucy Henning, Claire Baur, Bess Henderson, Daphne Whitton. . . . Ruth Timbie says that they are planning to live, retiring, in Leesburg, Fla. The Fossetts recall their two weeks visit to Alaska, reported here earlier, and at present they were skiing in Monmouth, Calif. They both are also mountaineers. . . . Ellie Cross encloses an article which announces the incoming President of the National Machine Tool Builders; our own (and hers) **Ralph Cross**, who goes on briefly to tell us his plans as head of this great group of machine men. . . . We are pleased to note that 1975 will not be a bad year. Lucy Henning comes through with their fine Christmas card; very elaborate, with 31 photos of their family and home life, and, a short account of their home and families, and, their travels, of which there are many. Most of these travels have been reported earlier,

here, but, their African trip included the Seychelles Islands, in the Indian Ocean, way off the African Coast. At home, they took in a farm in Ligonier, Penn. to study husbandry, and another in Vermont. Gee, I fear for George; he might get the bug as I did. As part of a male party, George also visited Laborador on a salmon fishing party, and, that, too, was successful. In November, Lucy and George attended a savings bank convention, or something, at the Boca Raton Hotel and Club, and, they both stopped here to see us on their way to a 747, Miami to California, where they were to spend Thanksgiving with one of their three daughters. They could not stay too long, but, for sure, they did our old hearts good. We love 'em. . . . Bess Henderson remembered us with the family card, most welcome, and allowed that old Slick was in South Africa visiting some of his relatives, and is retired. Bess is, and I quote, "a kissing cousin," and one of the Missouri Hendersons. Slick has never proclaimed any relationship between us, and I suspect that he is right, though the name hadda start someplace. . . . Daphne Whitton also sent us a card, and with it a rather long Whitton story; this will show later. A most enjoyable card came from the *Review Staff*, headed by John Mattill, and signed by all the lovely girls, here headed by my own Marjorie Lyon, Class News Editor. Leona and I appreciate receiving this rather big bunch of cards, and extend our best wishes to all. Thanks a million.

In addition to these cards, we had many fine Christmas family letters; again in order of receipt. These fine letters are more than welcome, but, contain so much news as to be slightly embarrassing, as the column is just not that big. From Daphne and **Beau Whitton** came a card: the Whittons, after a New Brunswick visit, stopped in Boston and talked with Westy, **Gene Sullivan**, and **Tom Galvin's** good wife Rita. With their card, came a copy of a letter from Rita Galvin, to the Whittons. It appears that Tom is now back to work, and without his brace, but using his cane as a safety measure. Also, Rita's note is replete with the Galvin family story. Son, Greg, is back home and attending a nearby college, after four years in the Air Force; Son Dave, the baby, will graduate in June from Colby College; and, daughter, Pat, is married to an M.D., and lives in Concord. (Mass?) Bob, husband, is hard at it, finishing up at Mass General Hospital. Golly, I, for one, am sure pleased to hear that Tommy is getting somewhere near normal, and working. I missed him at the Alumni Day, last June, as he always has attended, faithfully, with Rita. Many thanks, Daphne and Beau. . . . Daughter, Andrea, of Doris and **Len Julian**, is still working at her job as editor in the science publishing field, and loves California; Rodney and Pat gave up their jobs in June and took off on a 15,000 mile motorcycle trip, to 40 states and Canada. Daughter Sheryl is hard at work in her cooking profession, giving cooking lessons, and writes a weekly column for the *Washington Post*, and does a bit of consulting work. She expects to go back to Paris, soon, to work on a cook book based on the Versailles Palace. Len and Doris took a short month trip to Spain, Greece, and the Near East, last spring, visiting Madrid, Athens, Teheran, Istanbul, and Ankara. Doris is busy at her knitting, needlepoint, and patchwork, and, also is a cook. Len

wishes for longer days at his hobbies including a new one, stained glass window work, among many other things. He is active in, besides stained glass, wrought iron work, copper sheet working, enameled hot plates; he is also a gourmet cook and likes to fix autos. Golly, a man of many artistic talents, but, of course, he has to use both hands. Many thanks, Doris and Len. I wish I could use all of your good letter.

The **Werner Bachlis** now come through with their Xmas story, and welcome it is. Werner is now off the hook. He sort of had a lot of loose ends for a while, as I.G.E. did not know what to do with him, or so it seemed. He is now at work, G.E. Pittsfield, as project engineer, in environment protection work at the plant, where he is trying to assure G.E. that they are not in any violation of existing federal and state laws and regulations. They have built a ranch type house on 1.1 acres, in a secluded spot in Lenox, Mass. with a mountain view, and within easy walking of little Heidi's school. Werner now cuts his own wood, instead of hiking, and will have a garden. Werner and Heidi took a two-week trip, camping, where Werner was head leader, but Jeanette did not go, she stayed home to mind the store. It pleases me to find them both settled down, knowing what to expect, which they did not, before. Fine letter, Werner, and Jeanette, and thanks. . . . Now, we have a brand new correspondent, **Doug Stewart**, and his Louise. They have retired, and have moved from Whittier to Del Mar, both in California. Doug now has plenty of time for his hobbies. He is a working scuba diver, an addict of underwater photography, and works at it. I cannot verify the supposed chronology, but, I work it out that they drove to Houston in July, 1973, looking forward to a long trip to Curacao, flying from Miami, then to Bonaire for some diving; then back to Florida for some more diving in the Florida Keys, at Key Largo. Then, the long way home, in visiting family and friends; St. Augustine, Atlanta, Dayton, Minneapolis, South Dakota, (Rushmore), Canyonlands National Park, then home. In 1974, for scuba and photography, they sailed from Ecuador, via a 90-ft. three master, to Galapagos Islands, with an elderly naturalist as guide. See December *Esquire* for a write-up on these Islands (saves me space.) Spent a week in Panama, at the San Blas Islands, diving more. Back home, they spent Thanksgiving with daughter, Amey, in Sacramento, where she is attending Law School. Just as a short diversion, Doug plans a diving trip to Baha, Calif., to see the gathering spot of the gray whales, at their mating place after their migration from Alaska. By golly, Doug, you sure are the active fella. I can't work out if Louise goes with you, or enjoys letting you go yourself. In any event, your classmates will enjoy the saga of the scuba, and underwater photo. Many thanks, bud, we love it all.

Now for the **Jack Frost Andrews** letter; always a good one! In March, they took an American Express tour, accompanied by Jamie and the Dudley Woodbridges. This tour was to Mexico, via Yucatan, then to Mexico City, and Cozumel; a lovely week with congenial folks. The Blackstone Lake visit this year was as always, a high point, where the Andrews were joined by Jamie and Johnny from Colorado, Gwen from Montreal, and Val from Philadelphia. You might recall that Gail, daughter, with her

husband, moved to Brussels earlier. Now they have moved again, this time to Hulversum, Holland. Husband, Paul, has purchased a tire business and is hard at it. Jermain is still teaching at Miss Mason's school, including athletics, and Jack seems to keep busy following Jermain around. Great work if you can get it. Jermain appears to enjoy her social and cultural activities, with Jack in tow. Truly the Andrews are family folks, as they managed to have the whole clan at home for Thanksgiving. You will recall that it is quite a clan, as both Jack and Jermain have children, and hence grandchildren, to make up the clan. A handwritten note from Jack says that he intends to write me come the New Year. Again, kind folks, we thank y'all. . . . Earlier, you will recall that **Morris Cohen** was given the James R. Killian Jr. award of achievement. Now comes a real furor; Morris has been made an Institute professor. This one is about as high an honor as can be bestowed by our old school. The story will appear in the *Review* long before this column will. The astounding thing, to me, is that three classmates sent me copies of *Tech Talk*, which contained a long article on Morris' new honor; the classmates, **Norm Levinson**, **Ellis Littmann**, and one other, whose name I can't seem to turn up right now. Further, John Mattill, editor of the *Technology Review*, sent another copy of *Tech Talk*, calling my attention to Morris' being honored, and also the spectacular promotion of our long time friend, Don Severance, from his old job as executive vice president of the Alumni Association, to Director of the Volunteer Appeal, in the Institute Office of Research Development. I can point out that we will be hearing much more about this fine fella, a tower of strength and ability over many years. Don, our class offers our congratulations, and best wishes, in this new year, and in your new position. And, you hafta have a bit of luck, too, and this we wish for. . . . It might be appropriate for a mention of our own **Norm Levinson**, because he, too, is an Institute professor, if memory serves me properly. So, many thanks, Norm, and Ellis. You both came through when I needed you. I hope that the other classmate, whose name is gone from me, will drop me a line so as to allow me to mention his name, too. And, Morris, your class is proud of you, as we have always been, and as I expect we always will be. Naturally, I expect a personal note, sooner or later, as you can't hold out much longer. That concludes the card story, and the Christmas letters, and Morris Cohen. There is little left. . . . From **Walt Skees**, we have a little bit more than his stamped name this time. Now, he sends a short history of the Bahamas, with his photo attached, but, again, no message. He too, will break down sooner or later. We appreciate your holiday greetings, Walt.

We have no address changes this time, as I am writing this column early, because I expect to be out of town, at a Livestock Show, when the deadline arrives. We have one notice of the passing of a classmate, that of **Charles P. Woods**, of Cincinnati, Ohio. Charlie passed away on October 18, 1974. Again rather late in getting to me, is the notice. Fellas, it is obvious that you, every one of you, can see that late notification ought to be avoided, but I will not dwell on how. We are writing to Charlie's widow, in the name of the class, which is

about all we can do, even at such a late date. Should any of you wish to write, also, we have the address on file. That's it for this time around. My file of personal notes is now exhausted, so get a move on, and send me more and more personal news. No column is complete without such; in fact, it can't exist. New Year's greeting to all and sundry, especially those lovely girls who remembered Leona and me at Christmas time. We both thank you. — **Warren J. Henderson**, Secretary, 1079 Hillsboro Beach, Pompano Beach, Fla. 33062

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Let me begin with an item that was inadvertently omitted from last month's notes — notice of the selection of **William A. Baker** to receive the Award of Merit of the American Association for State and Local History. Bill, who is curator of M.I.T.'s Hart Nautical Museum and a lecturer in the Department of Ocean Engineering, was cited for research and writing contributing to a greater understanding of the Kennebec River regions and Maine maritime history. He is the author of "A Maritime History of Bath, Maine and the Kennebec River Region," a two-volume work published in 1973 by the Marine Research Society of Bath.

Once more **Ted Rimbach** sent me a copy of "Rimbach's Bulletin" — primarily a family news-letter but one from which I can glean some of his and Sylvia's comings and goings. This one, for special reasons, covered both 1973 and 1974 and it is worth going back to September of 1973 to note that the last of the unmarried next generations, son Don took the plunge. He also has converted 15 years of caving as a hobby into a profession as a consultant. One project has been battling the Corps of Engineers over a large dam that would destroy a major cave and, for extras, would be located in a site that was questionable geologically.

Ted and Sylvia had been at our reunion and Alumni Day and I find that this was just the icing on the cake — almost the entire trip east had been vacationing; sightseeing and visiting places on the Cape that were full of early memories.

I'm sorry to have to report the loss of two more members of our class; **Reuben M. Haines** of Lexington, Mass., and **Merton S. Neill** of Saddle River, N.J. Any of you who were active in the Musical Clubs or attended their concerts will remember Merton's performance on the xylophone. The sympathy of the class goes out to the families of these classmates.

To brighten the scene a little, I have some Alumni Fund notes that cover quite a spectrum. Mrs. **Margaret Z. Freeman** writes, "I retired last spring and am now Associate Professor Emerita in the Department of Foreign Literatures and Linguistics at M.I.T. I was appointed Senior Lecturer for this year — teaching half-time." Still avowedly at work is **Irving Kusinitz** who says, "I am still at my duties as Director of Engineering with Beatrice Chemical (Division of Beatrice Foods Co.). The first part of 1974 saw me in Venezuela and Mexico in May, Holland and England in June, and Venezuela again in July, this time with my wife Rose. She and I attended Ed Taubman's ('35) 60th birthday party in Baltimore in November and danced all night to Guy Lombardo, who played for the party. Some fun!" As I'm in the throes of

seeing whether another European trip can be planned for this spring, I can see the virtue of staying with a job that takes you around the way Irv's does.

Half way in between **Dick Sanders** notes, "still kicking! but spending four colder months in Vero Beach, Fla. — see phone book if in the area — otherwise still in Annapolis, Md. — also in the phone book." . . . I'm not sure whether **Ed Asch** is still with Vickers or retired, but he is staying put. He writes, "Sorry that we were unable to attend the reunion, but it's just too far to justify the trip, for such a short visit. We have no family left in the northeast and little visiting we could do with old friends. Besides, we love our life here in Texas."

Two notes come from classmates who have definitely stopped working. **Rodolfo Gonzalez Garza** says, "I am now retired. It would be a pleasure to greet any of the Alumni that may come to Monterrey, Mexico. Address — Emilio Zola 743, phone 432027. . . . This, from **Harry E. Heiligenthal**, certainly strikes a responsive note with me — "Retired and doing more now than when employed — only trouble is that the work is gratis! Really more fun now — would like to hear from some of the '34 course X boys." If any of you want to drop a line to Harry (after you have written me), his address is 130 Orchard Ave., Butler, Penn. 16001.

The final note is a very cryptic one from **Bill Ball Jr.** "Just tell him 'I'll be writing.' Becoming a Vice President of the Class in absentia warrants a letter." So I'll be looking for it, Bill.

To close with a personal note. We spent the week after Christmas on Long Island with **Eric Isbister** and Mora. Since this included New Year's Eve I was able to properly "first foot" him. He is busy working with Sperry Marine Division on harbor radars and collision avoidance systems and has had several trips to Europe in this connection. — **Robert M. Franklin**, Secretary, Satucker Rd., Brewster, Mass. 02631; **George G. Bull**, Assistant Secretary, 4961 Allan Rd., Washington, D.C. 20016

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All of the following notes have come to us through the Alumni Fund Office. **Hal Everett** writes, "Besides the 'regulars' at reunions I hope to see **Earl Megathlin**, **Vince Sorrentino**, **John Taplin**, **Luke Packard** and lots of other '35ers at our 40th. My youngest son Peter graduates from the University of Virginia in May so there should be no conflict. Spent an evening (alumni of Long Island) with Rhoda and **Bernie Nelson**; our loss on Long Island will be the Cape's gain. They are moving to South Harwich. Missed **Ollie Hoag** and his bride when they visited L.I. in October. Looking forward to June '75." . . . **Charles Piper** wrote from California, "When will the plans for the 40th be finalized? Maybe I can attend as an adjunct to a business trip thus saving mucho dinero."

A shorty from **John Holley** says, "Divorced again, alone again, starting over again, highly tighty." . . . **Ed Taubman** contributes this: "Not much change in my activities. Still in real estate which is real easy. Enjoying boating in the summer, stamp and silver collecting in the winter plus travelling at most any time. According to Webster, have recently become a sex-

again. Now I know where the "sex" has flown. Am looking forward to attending our 40th Reunion in June." . . . **Sam Brown** can relax now, but here is his message: "**Bob Forster's** October letter speaks of the 40th Reunion and says, 'we are looking into a night at the Pops . . .', etc. I am writing **Rufus Applegarth, Hal Bemis** and **Allan Mowatt** to urge the Tech Night at the Pops, on Sunday evening, is essential to a good reunion. Let us not just 'look into' it, but let's get it arranged definitely. My (Alumni Fund) contribution is increased 33.3% over last year and I hope that many of our class will do likewise."

Frederick Draemel rings some bells with his note: "I was allowed to use dinghies and wherries during the summer of 1933 and 1934 and appreciated this very much — it is one of my more pleasant memories of M.I.T." . . . **Bill Cross** writes: "Stepped aside as group vice president-international Kimberly-Clark Corp. to become senior vice president, January 1, 1974. Plan to retire from present consultancy status March 17, 1975. All children married — one grandson, one son board certified in internal medicine — Mayo Clinic, another is a banker, Berkeley, Calif., also banker son in Kalamazoo, Mich., and son-in-law board certified M.D. in Baltimore. Anna and I look forward to attending 40th Reunion in June." . . . "I retired for a year, then went back to work," is the short message from **Joseph Oldham**. . . . **John Shaw Cort, Jr.** noted, "Nothing exciting to report. Am still executive secretary for the local church, and will probably stay on as long as it keeps being a fun sort of job. The crises keep arising, but they are vastly different from those of the business world."

John Goffe Benson writes, "Peggy, my wife, who was at Simmons when we were all at M.I.T., after six years of heart trouble died this fall. Our children are all married and are scattered all over the world. Paul, the eldest, has been in London, England for five years. Stephany is living in Evanston, Ill. and John is in Oregon. I'm still hanging on as president of Union Carbide's Linde Div."

By the time you receive this, you will have received detailed information about our 40th and already registered to come. The Reunion Committee is headed by **Rufus Applegarth** with **Ned Collins**, Class President, as his chief assistant, and **Randy Antonsen** handling the funds. We will miss **Bob Forster** who left with wife Connie for three years in Sweden with Honeywell on January 18. Bob was chairman of both our 30th and 35th reunions. But we have an excellent committee including: **Chet Bond**, registration; **Ned Collins**, Program; **Ben Blocker**, transportation; **Allan Mowatt**, publicity; **Phoenix Dangel**, Photos; **Hal Bemis**, class gift; **Ed Taubman**, souvenirs; **Leo Beckwith** and **John Taplin**, reception (hospitality); **Elizabeth Haskins**, Jane (Mrs. **Peter**) **Grant**, Lee (Mrs. **William**) **Abramowitz** and **Eloise** (Mrs. **Prescott**) **Smith**, wives' activities; **Art Marquardt**, golf and miscellaneous activities; **Peter Grant**, speakers; **Ned Collins**, Bicentennial. We also have the following at work contacting fraternity members and those who were in the following courses or groups: **Bernie Nelson**, Beta Theta Pi; **Pete Grant**, Phi Gamma Delta; **Chet Bond**, Phi Kappa Theta; **Bissell Alderman**, Kappa Sigma; **Art Marquardt**, Delta Upsilon; **Leo Beckwith**, Sigma Alpha Mu; **Randy Antonsen**, Sigma Alpha

Epsilon; **John Taplin**, Phi Delta Theta; **Allan Mowatt**, Chi Phi; **Gerry Golden**, 5:15 Club; **Bernie Nelson**, Course I; **Frank Sellow**, Course IV; **Ben Blocker**, Course V; **John Taplin**, Course VI; **Dick Jarrell**, Course VIII; **Phoenix Dangel**, Course VII; **Tony Dauphine**, Course X; **Ned Collins**, Course XVII; **Betty Haskins**, Course XVIII and the girls in Course IV; **Allan Mowatt**, crew. So contact your old friends and be sure they will be at the 40th so you can renew and/or continue those friendships. The next big chance to get together isn't for another ten years. See you there at M.I.T. June 5.

It is my sad duty to report the deaths of two of our former classmates: **Joseph M. Colby** in Ft. Lauderdale, October 18, 1974, and **George O. Hutchins** in Braintree a year ago, May 21, 1974. Our deepest sympathy is extended to the surviving members of their families. — **Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

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The year's end brought a flurry on contributions to the Alumni Fund and news to your secretary. For both, we are grateful. **Fred Carten** writes that he is retired and happy in Florida. He is serving as chairman for the Salvation Army and president of the Home Owners Association and still has time to travel. . . . **Martin Gilman** reports that he is a little busier than last year because he hasn't given up anything and has added new activities, primarily the Appropriations (finance) Committee in Lexington. He has also been playing the carillon in the Town Hall in Norwood and attended the World Carillon Congress in France last fall. . . . **Laddie Reday**, as intrepid as ever, spent considerable time with his wife travelling and hiking on their own in Western and Central Siberia and Outer Mongolia. Their trip last summer took them over via Japan and home through Taiwan, Hong Kong and a tennis tournament in Hawaii. Laddie writes that he is "winding down Western Water" but that his Newport Properties is booming. . . . **Richard Lane** lives in Pleasant Lake, Michigan and is director of marketing for the Frank Bancroft Company of Dearborn, manufacturer of resinoid grinding wheels. . . . Captain **Richard Anderson** writes that now that he is "retired from naval shipbuilding, he is managing his plantation which was the first to be reforested in South Carolina some fifty years ago. He is also serving as a consultant on the restoration of the local Parish Church in Stateburg which is a national landmark.

I am sorry to have to report the death on June 1, 1974 of **Joseph W. Epply, Jr.** of Kingston, New Hampshire. I have no further information. . . . On August 2 the class lost another member, **John R. Graham** of Newport Beach, California. A vice president of Global Marine, Inc., he had been responsible for the designs for the Glomar Challenger and the Hughes Glomar Explorer. . . . **Paul E. Smith** of Indianapolis died May 5, 1974. . . . **Arthur M. Cohen** of Westport, Conn. died recently. Mr. Cohen had retired a few years ago after having sold Electric Regulator Corp. He is survived by his wife, son, and daughter. To their families, the class extends its sympathy. — **Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, Conn. 06091

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Philip Bliss is still in instrumentation with Pratt and Whitney Aircraft Division. He also is director of Intersociety Standards I.S.A. and active in standards of A.S.T.M., A.N.S.I., I.E.E.E., and A.S.M.E. His son, Alden, is in Honolulu; son, David, is married and lives in Brighton, England, and Jonathan is at Northeastern University. His daughter, Deborah, is teaching in Philadelphia. . . . Hsu Yun Fan, '34, is a Duncan Professor of Physics, Purdue University. . . . **Hjalmar Bruhn** recently attended International Agricultural Engineering meetings in Holland and contributed two papers; one on processing of aquatic vegetation as a means to mechanical control and one on dewatering of alfalfa and production of juice protein fraction. He is still a professor at the University of Wisconsin. . . . **Jack Simpson** is retired from Warner Gear Division of Borg-Warner. He married Mrs. Virginia Kem-brough in September, 1974, and they are living in Sarasota, Fla. . . . **Bill Penn** has just been elected a fellow in the I.E.E.E. He is manager of materials and processes for direct current motor and generator products department of G.E. in Erie, Penn. — **Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, Mass. 02155; **Lester M. Klashman**, Assistant Secretary, 198 Maple St., Malden 02148

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The big news this month is that **Don Severance** no longer is Executive Vice-President of the Alumni Association. I am not sure whether this is early retirement or a promotion, but Don is now Director of the Volunteer Leadership Appeal in the M.I.T. Office of Resource Development.

George Morel writes, "In 1972 I was given early retirement by Abex Corp. I then moved to Asheville, N.C. In August 1973, my wife, two daughters, and I had the fulfillment of a lifetime. We toured Europe for ten months in a camper. I am now a professional employment counselor for Kogen Personnel here in Asheville." . . . A note from **Clark Robinson** says, "I have been spending the last six months on sabbatical leave at Montana State University, Bozeman, studying theory. I would like to find someone who will join me in hiking the entire boundary of Yellowstone National Park."

Nick Barbarossa is now director of planning and technical services for the Missouri River Basin Commission, composed of governor-designated representatives of ten states and ten federal agencies and two comparts. The commission has the statutory mandate of developing a comprehensive coordinated joint plan for conservation, utilization and development of the water and related land resources of the Missouri River Basin. . . . **Peter Cole** is presently employed by Ketrion, Inc., Arlington, Va. — weapons systems analysis. In particular, electronic warfare and electro-optical systems. Avocations — gardening, golf and sailing.

The December class notes were in part written by me, and without my knowledge, my associate class secretary sent some additional material direct to Cambridge, with the result that **Ed Hadley** got so confused that he sent me a note giving his love to my

wife Henri.

One of the sad duties of a class secretary is to report the death of a classmate. **Jay AuWerter** passed away last December having had a stroke. If he had to die it was the best way because he apparently suffered no pain and it was sudden. — **A. L. Bruneau, Jr.**, Secretary, Hurdman and Cranstoun, 140 Broadway, New York N.Y. 10005

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Betty and **Ryder Pratt**, in St. Louis, represent those who are less-nomadic because they have lived in the same house for more than 20 years. Ryder combines overseeing his business interests in a foundry and some metal working companies with vacationing in Arizona. . . . **Dave Bartlett** was vacationing in South America during December, but he has not yet reported whether he found any Republicans there. . . . **Aletta** and **Bob Touzalin** will be skiing again at Aspen during February, but Bob did not say whether or not the President has asked for an appointment for consultations between sitzmarks.

Al Laker, from Los Angeles, and **Connie** and **Manning Morrill**, from New York, and **Bob** and **Maisie Fife**, '40, from Aptos, Calif., and **Olaf** and **Tullen Rustad** ('40 from Oslo), all sent beautiful Holiday Greetings. . . . **Dick Feynman** took time off from California Institute of Technology to speak enthusiastically during a NOVA program which appeared recently on our local educational TV station. His topic was "Take the World From Another Point of View" and, as ever, Dick was stimulating.

Luna and **Leo Kiley** live in St. Petersburg, Fla. where they enjoy the Gulf and where **Leo** is General Manager of G.E.'s Neutron Devices Department. . . . **Ernest Ohsol** is Chief Process Engineer for Jacobs Engineering Co. at Mountainside, N.J. . . . **Lois** and **Ken Cook** visited U.S.S.R. for a month during which Ken presented a paper on earthquake prediction.

Wilbur Vincent moved to Schenectady where he is manager of manufacturing for G.E.'s Apparatus Service Business Division. . . . **Charles Jeffus** has retired to Greensboro, N.C. after a career including military engineering, nuclear engineering management, and engineering education.

Francis Sargent, formerly Governor of Massachusetts, will become a Fellow at the Institute of Politics of the Kennedy School of Government. . . . **Walter T. White** is teaching Engineering Analysis and Experimental Laboratory at Texas Tech University. . . . **Harold L. Smith** has been elected a Vice President of Eastman Kodak Company and his duties include general management of the Kodak Park Division. Our congratulations to Harold who has been with the same company since graduation 35 years ago! — **Hal Seykota**, Secretary, 14650 Island Drive, Jacksonville Beach, Fla. 32250

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Don't forget the forthcoming class reunion in June. As a result of Christmas this is a newsy column. From **Marion** and **Garrett Wright** comes the following: "It's the day after Thanksgiving and we are watching the first snowfall of the season from the snugness of our home. Day is dying and our

thoughts are scattered. We are thinking of July, Les, Matthew and Marcus far away in the Arctic wasteland. There they are truly pioneers — teaching in the tiny Eskimo community of Nulikut — far from the comfort of civilization. Their letters tug our heart strings but they are full of strength and faith. Our thoughts are with Janet, E.G. and Luke, back again from Africa and waiting the arrival of the Christmas baby who will join our family. Will it be our fifth little grandson or a first granddaughter? We plan excitedly to spend Christmas with them all in Madison, Wis. We are missing Irma, Gary and Little Andrew (now a year old). He was born here in Springfield and we had the joy of their nearness in Neosho for a year. Now they are making a new home in Corvallis, Ore. We are remembering our excitement a year ago today as we flew from Nairobi, Kenya to Kusaka, Zambia and were met by our dear Janet, E.G. and Luke; there to live and travel for nearly three weeks. We are thinking of our new friends Meg and Ken Titmus in Devonport, Tasmania. When we arrived at their home last Christmas we were polite strangers. In this short year we have shared Christmas and a wedding in Australia and a five week, 7,000 mile trip across the U.S.A. from Kitty Hawk, N.C. to San Francisco. We are hardly strangers now! Finally our thoughts are with all you dear ones far and near; the texture of our lives is rich because of you, each one, and our shared love. Two full years — how can we chronicle them? Marion's fascinating four months on the grand jury from January 8 to May 8, 1973. Garrett's venture into 'politics' running as an at-large candidate for City Counsel in 1973 and winning a four-year stint along with hundreds of hours of unpaid work. Garrett's retirement from Wright and Assoc. in 1974. Restful trips to Kitty Hawk. Gary and Irma's arrival in Missouri, a couple of months with us and the decision to try pediatrics in Neosho; the birth of dear little Andrew, November 10, 1973. Our fabulous trip to Senegal, Kenya, Zambia (with side trips to Victoria Falls, Lake Tanganyika, and the copper belt), Mauritius in the Indian Ocean, Perth, Adelaide, Melbourne, Davonport for dear Karen's wedding, and finally Honolulu where we met Mom and Virginia for New Year's Eve. Around the world in 49 days! A visit in June, 1974, by our Alaskans — such happy days! A ten-day family reunion in Kitty Hawk in late July — a complete joy — brothers, sisters and in-laws forging closer bonds — happy Grammy and Granddaddy — four little cousins learning to love one another. Our lovely U.S. trip this fall from coast to coast including Newport News, Williamsburg (we were married there — remember?) Boston and Lexington, Niagara Falls, Canada to Windsor, Madison, St. Louis, Springfield, across Nebraska to Cheyenne, Jackson and Yellowstone and The Tetons, Boise, The Dalles, Oregon, Coast, Corvallis, and San Francisco. A wonderful way to prepare for the Bicentennial. So, two full years have passed and we look ahead with interest and faith. Come what may, we're sure the future won't be dull."

The next Christmas note is from **Masimo Baer**: "You make me feel very guilty. I have always neglected answering your kind greetings. Perhaps unconsciously I am trying to forget my hard days of work at M.I.T. One thing stands out in my mind: you were of tremendous help to me since frankly, I

had never been exposed in Italy to practical problem solving. After almost 35 years I want to thank you for your generous help. Well, we cannot complain. Health is good. Play a lot of tennis and go skiing. Have a wife (also imported from Italy) and two sons 23 and 25, the youngest doing social work and applying for a doctor's in psychology while the oldest is married with a son and is studying meteorology after having obtained a masters in economics (does that make much sense!) I like my work in research at Monsanto.

With regret I must advise of the death of **John Titherington** on November 25, 1974, as well as the death of **Larry Teich** who was killed in World War II. . . . **Dan Crosby** needs help: "I'm busy as hell keeping the state of Connecticut from blindly continuing the superhighway program as if no fuel or environmental crisis existed! We're \$28,000.00 in the hole to lawyers. Need \$1.00 from every '40, C.B.E.T. Foundation, Box 212, Wilton, Conn. 06897 NOW." . . . From **Doug Eckhardt**: "Lois and I are getting accustomed to being midwesterners. Our three children and two grandchildren spread from Maine to Missouri. We are looking forward to June reunion."

Ted Gundlach writes: "See only one Tech man regularly — Win Hartford, '30. Presently rock collecting and teaching chemistry at Belmont Abbey College. Babysat for grandson Jono (pronounced Wano) in Irvine, Calif. last summer. Younger son and wife expecting one, two or ?? in February 1975 (she's a twin!)." . . . **Ted Edwards** notes, "I am with Envirotech Corp., EIMCO, TMD Division employed as district manager, sales. The company among other things makes mining equipment and I am with the Tunnel Mining Division. . . . **Louis Berger** has been elected a charter trustee of Tufts University. He is president of Louis Berger International, Inc., of East Orange, N.J., an international design firm. He started 26 years ago. . . . **Robert Davis** is president of the new International Trade Division of Champion International. . . . **Herb Hollomon** has been elected a foreign member of the Royal Swedish Academy of Engineering Sciences. . . . Write — **Al Guttag**, Secretary, Cushman, Darby & Cushman, 1801 K Street, N.W., Washington D.C. 20006

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As the deadline for March/April '41 class notes approaches it is only January 13 but, there are items of news: **John Stadig** is with Dow in California. His address is 801 J Street, Davis, Calif. . . . **Sterling Ivison, Jr.** writes that in September '74 he started his second career as professor of finance at the School of Business Administration, The American University, Washington, D.C. . . . **Stanley Marple**, writes "things have been pretty smooth — no big events." He is doing chemical engineering with Shell Oil in Houston. . . . With energy and oil one of the biggest problems it shouldn't surprise us that one of our illustrious classmates wrote a *New York Times* op-ed report on "New York City and The Oil Problem." **Howie Samuels** who was listed in this article as "A Business Consultant" stated, "The time has come for a combination of the national, state and city governments to provide large-scale tax and job training incentives to rebuild New York's

economy. Either jobs will be moved in — or people must move out. There is no alternative."

Saul Gifford, is president and director of Gifford Instrument Laboratories, Inc. in Oberlin, Ohio. . . . A note from **Donald K. Duffey**, who works for design division of DuPont's engineering department for biochemicals says he sees Chuck Hunter who graduated with him with a masters degree in '41. . . . I run into Bernard Ericson in our U.S. Steel building. He's Senior Application Engineer for Blast Furnace and Raw Materials. He says he started in 1937 with our Class but took the five year XIIC course so is officially in 1942. He has many friends in our class. . . . I ran into **Bill Baldwin** in the William Penn Hotel recently. He is working for a French Company — Pechiney — in Pittsburgh. This note is to remind Bill we are to have lunch one day. . . . **John Wallace** is professor and acting chairman of the department of metallurgy at Case-Western Research University. He has been there 20 years and lives in Shaker Heights. This May in St. Louis he will give the Hoyt Memorial Lecture to the American Foundrymen's Society. . . . Send in more news, we can handle it. — **Henry Avery**, U.S.S. Chemicals, 2863-600 Cerant St., Pittsburgh, Penn. 15230

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Russ Estelle's son John is majoring in E.E. at Drexel. . . . **Harry Maynard** is still manager of Bellevue (State of Washington) Chamber of Commerce. His daughter Ellen is in the Navy Nurse Corps, his son Charles is a sociologist and son Steve a journalist. . . . **Charlie Kennedy** is still operating his Community Country Day School in Erie, Penn. doing a wonderful and inspiring job running his free school for socially maladjusted children and for high school drop-outs. He is still working part time for American Sterilizer Co. designing pressure vessels which produces a living to help support the Community Country Day School. . . . Our class Treasurer, **Marty Levene** reports a busy year as president of the Boston University School of Medicine Alumni Association and working on a proposed research project in the Harvard/M.I.T. School of Health Sciences and Technology.

Carl Zeitz says that he is still active in his family business — part time! Also he has stayed with the golfing fraternity and has not been seduced by tennis. His daughter Marjorie is a commercial artist with a greeting card company and Barney is making and selling stained glass windows all over the country. Carl says he gets really high prices and does not know where Barney or Marjorie get their artistic talent from! . . . **Chris Peek** is now vice president of Product Engineering at E.C.A. right next door to M.I.T. Chris's big task these days is keeping up to date which he does by doing experimental work in his own ham shack at home. . . . **Ed Holland** is still at his home base in Washington, D.C. doing a lot of international travel and getting in some interesting research in his work with the Transportation Research Division of the World Bank. . . . **Alan MacNee** completed his latest text book "Introduction to Modern Circuit Analysis" and then took a month off fishing and relaxing in the beautiful Olympic Peninsula and in the Pacific Northwest. . . . **Myron Johnson, Jr.**

recently opened a consulting service in microclimatology for architects in Cincinnati. His aim is to help architects in the consideration of energy conservation and life cycle costing in building orientation and design.

Usual number of quotable quotes from **Charlie Smith** in his role as chairman of the Chamber of Commerce of the United States. In an interview after his attendance at the Economic Summit Conference, Charlie strongly commented on the fact that many of our Congressmen definitely lack the will to do something about actually reducing federal spending. He has also continued his strong opposition to unrealistic public assistance to strikers which in fact causes the consumer to pay twice; once through taxes to subsidize strikers and then later through higher prices in the market place. . . . **Robert Seamans** was appointed head of the new Energy Research and Development Agency and was quoted in a New York Times editorial as saying, "Balancing this country's energy budget will be a tougher job than putting a man on the moon. The Manhattan Project and Project Apollo do indeed seem relatively simple compared with the national energy challenge, for they were aimed in quite specific technical goals."

Frank Staszsky, Executive Vice President of the Boston Edison Company has been elected to the Board of Directors of the Atomic Industrial Forum. This is a not-for-profit international association of more than 600 organizations interested in the peaceful development of nuclear energy. . . . **Jim Littwitz** and **Floyd Lyon** have been appointed members of the M.I.T. Club Advisory Board. The Board is continuing its evaluation of Alumni leadership and helping to give direction to local Club activities. . . . **Geza Neuman**, **Bill Van Nosttrand** and your secretary represented our class at the special meeting of the M.I.T. Alumni Center of New York. We heard a very interesting address by Governor Luis A. Ferré on the happy development of M.I.T.'s Council on the Arts. . . . Talked with **Moe Steinberg** during a trip to the Coast last fall and he is still busily engaged in being chief scientist at Lockheed Aircraft. . . . **George Toumanoff** recently attended the S.R.I. sponsored conference in Moscow for the purpose of acquainting top western business executives with their Soviet counterparts. George said that the trip and conference were most interesting and of course, especially for him since he speaks Russian fluently.

Among our retirees the following: Rear Admiral **David Kinert** has now re-retired from his second career with Pacific Far East Lines. . . . **Maynard S. Renner** retired and is now chairman of the Fitchberg-Gardner-Leominster Chapter of SCORE (Service Corps of Retired Executives). This is an agency of the U.S. Government consisting of retired executives who use their experience and expertise to give advice on business problems. . . . **Robert Breckenridge** has retired after serving as head of the physics branch of the Office of Naval Research, chief of the Solid State Physics Section of the National Bureau of Standards and later as director of research of National Carbon Co., a division of Union Carbide Corporation. . . . We wish the best of health and happiness to our newest crop of retirees. — **L. K. Rosett**, Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

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Chris Matthew of Greenbrae, Calif. has been named president and chief executive officer of the Arthur D. Little, Inc., subsidiary Lester Gorsline Associates, planning and management consultants for health institutions, located in San Rafael, Calif., a suburb of San Francisco. He was with St. Mary's Hospital in San Francisco where he has served as Associate Administrator and Director of Planning since 1967. Chris joined Arthur D. Little, Inc., in 1943, and in 1954 he moved to San Francisco to establish the company's Western Division, where he served as Manager until 1963, when he became the President of Research Specialties Company, a manufacturer of instruments used principally in clinical and chemical laboratories. Active in local professional, civic, and religious organizations, he recently completed a three-year term as a member of the Board of Trustees of the Catholic Hospital Association. He serves on the M.I.T. Educational Council and Scholarship Committee and is a member of the Family Club and the World Trade Club of San Francisco. He served as the first chairman of the board of Westside Community Mental Health Center, Inc., for two years and was chairman of the board of Catholic Social Services of the Archdiocese of San Francisco. He is the immediate past chairman of the Lay Advisory Board of Mount St. Joseph's Home for Girls. Chris drives with MIT-43 as his license plate here in California, and your secretary has plain MIT as his.

Jack Kelly wrote as follows: "A 'sneaky way' to get a quick 'hello' to you! This year is another one of those 'Here it comes . . . there it goes years!' Was in Japan just after the New Year . . . then to Spain, Germany, France, Holland in April . . . then in September, to London to Tokyo to West Coast U.S.A. and to Fort Worth, Texas, for R & R with Lois and No. 2 son and wife. Our Butterworth marine equipment business is having a very good year. The world's shipyards are still building ships like crazy thanks to the orders of 3-4 years ago. I'm Chairman of our Butterworth Systems affiliate in the U.K. in addition to being president of the U.S.A. company. This keeps me hoppin' . . . I made my Alumni Fund Pledge to the Telethon caller last week . . . so I'm 'In For Dollars' again this year!"

From **Sid Atlas** we received the following bright note: "Still prospering as an air conditioning contractor in glorious Houston. Oldest daughter graduated Colorado. Two sons at Texas, youngest girl in high school. Play lots of tennis and golf. Still keeping good shape and kept my hair. Enjoy Education Council work." . . . **Bill Voorhis** wrote that he is still with General Instrument in Hicksville, Long Island. He was remarried last July and said he is looking forward to bringing Ruth to our next reunion in 1978. . . . **Bob Rorschach** was elected president of Data Systems Corp., in Tulsa, Okla. in September, 1974. He is chairman of the Tulsa City-County Environmental Advisory Council, a member of the M.I.T. Alumni Advisory Council and on the Board of Directors of the Alumni Association. . . . **Whitney Newton II** was recently elected vice president for research, Holly Sugar Corp. in Colorado Springs. Whitney has been in the sugar business ever since graduation having been employed by Great Western Sugar Co. as



A Champion for Engineers' Pension Rights

What happens to your pension rights if you're working for an electronics company on a government contract which is terminated, and the company then lays you off? Should the government be responsible for the pensions of engineers and other professional workers trapped in such circumstances?

John Guarrera, '43, has spent most of his term as President of the Institute of Electrical and Electronics Engineers pressing the importance of these questions on members of Congress. The result is that when President Gerald Ford signed the Pension Reform Act (H.R.2) on Labor Day it included a requirement that the Labor Department study government procurement policies and report within a year if and what changes need be made to protect the pension rights of workers on government contracts. And firms with existing pension plans must pay a yearly fee to the government to help finance protection of professional workers' pension rights if the firm goes out of business. Mr. Guarrera was present when the law was signed (above), and he later received a commemorative pen from the President. (Photo: I.E.E.E.)

vice president and general manager of its research division. Later he had his own consulting firm in Denver.

Marjorie K. Smith wrote that she is still busy as a training specialist in the Bureau of School Health for the New York City Department of Health, and also conducting a lot of childrens' clinics. She wrote that she spends her spare time traveling. . . . **Melvin Lax** who is distinguished Professor of Physics at the City College of the City University of New York is the author of a new book published by John Wiley & Sons last October, entitled *Symmetry Principles in Solid State and Molecular Physics*. He has been a member of the technical staff and head of the theoretical physics department at Bell Laboratories, and is presently a consultant to the Solid State Electronics Research Laboratory there. He has taught at Syracuse University, Princeton and Oxford. A former member of the Board of Editors of the *Physical Review*, Dr. Lax obtained his

Ph.D. in physics with our class. He has published about one hundred papers that range from acoustics and meson physics to most areas of solid state physics.

The Alumni Fund year ends June 30. Class president Ken Warden sent us an inspiring message; it deserves your generous response. — **Richard M. Feingold**, Secretary, 3757 State Street, Santa Barbara, California 93105

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A bargain price for the gala 30th Reunion we have in store for you and yours at Chatham Bars Inn June 6-8 is \$199.95. You received in early February a 30th Reunion mailing that went to the 468 individuals that make up our class giving you all the details, upon which you should have made an affirmative decision. "Yes" means you plan to attend! When you consider the arrangements the Alumni Association has made with the airlines, Boston Bicentennial Comm. etc., you can have a great sojourn in early June.

These notes are being written prior to the aforementioned mailing so I must guess as to what you have received. Many of you will also have talked about our 30th with a committee member during our February telethon. We look forward to seeing you in Cambridge and Chatham in early June.

Gerry Quinnan is Reunion Chairman with able assistance from **Frank Gallagher**, **Bob Maglathlin**, **Charlie Hart**, **Bill Shuman**, **Charlie Patterson**, **Jim Pickel**, as Reunion Treasurer, plus **Tom McNamara** and yours truly as exofficio members.

Recent issues of the *National Fishermen* have included ads for a Fales 38 Navigator which is a 22,750 lb. motor sailer designed by one **Chick Street**. The vessel has 6' 6" head room which means that old Chick can almost stand upright! . . . **Don Lovell** writes that he enjoys life as an optical consultant, i.e. Dr. Hardy's training paid off! Don has been testifying in court as to the motorist's ability — or lack thereof — to avoid collisions. . . . **Ed Stoltz** is now Operations Manager — Growth, Planning & Development Division at Johns-Manville in Denver. Daughter Sue attends Southern Colorado State, son Ed is at Colorado University, and 11-½ year swinging Elizabeth is now in the sixth grade. Yes, Ed, Elinor and company will be at Chatham Bars.

Darwin G. Traver reports that after 22 years in Syracuse one becomes oblivious to the weather. Hard to believe when you consider Darwin is a Senior Staff Engineer at Carrier Corp. As to family — wife Adeline, daughter Anita, Mt. Holyoke '74 and son James a Junior at Harvard. . . . **Henry F. Lloyd**, '46, reports that he has been administrator at Flaglor College in St. Augustine, Fla. since his retirement from the Navy in 1968. . . . **H. Paul Grant**, after goodness knows how many years in the Harvard Square area, has joined Pratt Whitney Aircraft in East Hartford, Conn. The Grant Rundown — two kids married off, another working in Chicago, two more in college, remaining three in High School. Will come up for air in 1982!

Many of you — especially old Company 2 people — will remember Abbott Fletcher, '47. Since graduation Abb has been at Bath Iron Works and from what Hap Poole, '48 (also an old classmate) tells me, it has been

a real fine life. Last summer Abb accomplished the impossible in winning the Gulf of Maine Ocean Racing Circuit in his Tripp 37 Majek by finishing with a perfect score of 1000 points under the Cox-Sprague scoring system. A good show under any circumstance!

And now for the Christman Card Review — **Lou and Pete Hickey** with pictures of a new four-month-old granddaughter, the **J. J. Strad** family with 8-10 pictures of the tribe on a fishing trip to the Minnesota Border Lakes in August 1974. . . . A note from **Dave Trageser** advising that he continues up to his armpits in work. . . . A letter from **Mary and Nick Mumford** advising that they would be unable to join us in June. The 12 inches of snow on the ground at the time Nick wrote caused the Mumfords to plan a Caribbean vacation in January! . . . Brief notes from **Ellen and Jim Brayton** as well as **Jimmi and Tom Stephenson** of Alcoa, Davenport, Iowa. . . . A great snapshot of **Buzzy, Lynn, Diane, Bobby and Vince Butler** with Monterey Bay in the background. . . . **Lush Hawaii** with **Louise, Laura, Carolyn, Dick, Julia and Sherry Ing** in the foreground.

The usual, wonderful and original home made card from the **George Bickfords** as well as nice notes from **Jan and Charlie Paterson** in North Attleboro; **Lib and Jerry Patterson** from Binghamton, N.Y. Oh yes, good old "G. B." **Hetrick** our enterprising builder and landlord from Lancaster, Penn. . . . **Trudie and Max Ruehrmond** advised that they would be on the Cape in June as did **Billie and Al Bowen** and **Jean and Chris Boland**. Will you be there too?

Frannie just proofread these notes and said what about our family! **Curtis** is a Junior at Dartmouth, **Betsy** has followed her mother to Smith while **Jon**, our High School junior, thinks he is another **Bobby Orr** — no such luck! — **Clinton H. Springer**, Secretary, Box 288, New Castle, N.H. 03854

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Peter Wright advises he and the family have returned to the Bay State and now live at 119 Smith St. in Leominster. Peter and wife, **Naomi**, commute to Boston, **Naomi** to Necco where she is the executive secretary to the president and Peter to the Prudential Center where he works with **Charles T. Main**. Peter would like to hear from classmates in the area.

Ernie Buckman reports he is a first time grandfather, a grandson, **Jerome**, born to the Buckman daughter and her husband with the Chase Bank in Hamburg, Germany. . . . A nice note arrived from **Ralph Berman** advising he is still developing high rise buildings in the center of Montreal with his long-time partner. They have opened a branch in Edmonton, Alberta and have begun construction on a 22-story office building in the downtown area. **Ralph, Edith** and their sons, **Brett and Patrick**, who you all remember from the last reunion, are well and looking forward to the reunion in 1976.

John L. Bateman has returned to Long Island to continue in clinical medicine. The Batemans have three offspring in college and **John** recommends the challenge. . . . **Nathaniel F. Rodman, Jr.** has moved to Morgantown, W.Va. and is chairman of the Department of Pathology at West Virginia University Medical Center where he is enjoying the challenge of the new job and the

mountain terrain. . . . It's been a long time since the last word but we have heard again from **Edward L. Belcher**. Ed lives in Rochester, N.Y. with his four children of 12-17 years. Ed's major involvements are the children, Caldwell Manufacturing Co., an art gallery, sailing, and politics. Ed ran unsuccessfully for Town Council in 1973 but his interest hasn't abated.

Robert F. Nelson, Jr., his wife, Marianne, their three children and two nephews participated in an unusual vacation last August. The group bicycled from Georgetown (Washington, D.C.) to Cumberland, Md., following the towpath of the old Chesapeake and Ohio Canal. The 184-mile trip took six days, and while it was mid-August the temperature was quite cool as the towpath is tree shaded. . . . **Richard M. Adler** is now with Avondale Shipyards, Inc. as assistant project manager for the contract to build three large liquefied natural gas tankers. Richard continues to be active in M.I.T. Educational Council. . . . **Richard Gliedman** has been appointed associate professor in the Department of Orthodontics at Columbia University School of Dental and Oral Surgery. . . . **Kurt Goldmann** has joined Transnuclear, Inc. of White Plains, N.Y. as chief engineer. . . . **Robert L. Jacks** has been elected a Fellow of the American Institute of Chemical Engineers.

We must sadly report the death of **Clarence T. Ford** on March 15, 1974. Clarence died suddenly of a heart attack on that day. Clarence left his wife, Mary Elizabeth, and five children.

Until the next full mail bag, sincerely, — **Russell K. Dostal**, Secretary, 18837 Palm Circle, Cleveland, Ohio 44126

47

My apologies for missing the last issue but a golfing vacation in Florida plus the holidays really fouled up my schedule. Notes from the Alumni Fund envelopes advise the following: **Dave Brown** is U.S. co-chairman of the second U.S.-Japan computer conference to be held in Tokyo in August, 1975. . . . **Morgan Cooper** has left Oak Industries after 15 years to join the Ansul Co. as head of their engineered system business. He is keeping plenty busy between work and enjoying the many recreational activities offered by Northern Wisconsin.

Eugene Woestendiek was recently promoted to Chief Design Engineer of the Ferro Alloys Division of Union Carbide. In this position he remains in Niagara Falls, N.Y. . . . **Hugh Lavery** is still doing process engineering with International Paper in upstate New York. **Walter Kern** advises that his daughter, Jill, is a freshman at Tech in earth sciences and enjoying her living group — French — German in Ashdown House.

Ginny Ferguson Hildebrand was married in August, 1974 to William Ean of Seattle. Her three children are now in college. A son is at M.I.T. and a son and daughter at the University of Puget Sound. Ginny — our best wishes. . . . **Richard Barker** is now manager of quality and reliability engineering at Interdata Inc. in Oceanport, N.J.

Harlow White writes that in October of 1974 he married Patricia Sunderland. His wife, Rachel, Wellesley '44, having died in October of 1973. His son Philip is an Army Flight Surgeon, his daughter Kathrine, Wellesley '72, a med student at the Univer-

sity of Maryland, his daughter Katherine, a senior at Simmons, his daughter Mary Alyce, a freshman at Maryland Art Institute. Maybe Harlow was really enthralled with the name Kathy or maybe I can't read but it is early in the morning and that is what he says. In any event he is still with Shenandoah Plastics a concern he helped found in 1967 in Frederick, Md.

Tom Cummings spent a year in England returning with three of his children in a 26-ft. sailboat. They left Poole, England on May 31 and arrived in Pensacola on August 21. That must have been quite an experience. . . . **Bob Whorf** left Ford and joined Gellman Research Assoc. in Jenkintown, Penn. as executive vice president. He now resides with his wife, Anne, and three sons in Elkins Park, Penn. . . . **Francis Schanne** obtained a master of engineering degree from Penn State in late 1974.

Saving some of the best until last, I am very pleased to see that **Claude Brenner** has been named vice president and general manager of Laser Graphic Systems Corp. in Sudbury, Mass. This concern makes a letterpress plate-making system for the newspaper industry and is a joint venture of Gannett, the newspaper publisher and Applied Laser and International Laser Applications and Management Co. Claude is becoming a real native to Massachusetts as his shift from E.G. & G. doesn't even require a move. . . . We received a nice Christmas card from Claire and **Bob Seidler** who should be having some relaxation with all of the children away from the nest at least for the present. . . . I had a pleasant evening with Don Merriam, '49, and his wife Jean in Allentown, Penn. Don started with a lot of us at the Institute. He is still President of Buckeye Pipeline who moved their headquarters from New York to Allentown. Until next month. . . . — **Dick O'Donnell**, Secretary, 28516 Lincoln, Bay Village, Ohio 44140

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Charles H. R. Campling completed the 1974 Boston Marathon (April 15) in just under 13½ hours. **Edwin S. Rich** of Lynnfield Center, Mass. (and Mitre Corp.) was a member of Campling's "pit crew." . . . **J. Kail Crane** is currently serving as president elect of Chicago chapter of the Illinois Society of Professional Engineers. Crane served on the program committee of A.S.C.E. Chicago Engineers Club Friday luncheons during 1974. . . . **Jay Lathrop** suffered a heart attack in 1973, but made a good recovery and spent the summer of 1974 on a walking tour of England, Scotland and Ireland.

Donald J. Atwood was appointed general manager of the General Motor's Delco Electronics Division in Kokomo, Indiana on October 1, 1974. . . . In 1970 when the Detroit Diesel Engine and Allison divisions were merged to form the Detroit Diesel Allison Division, Don was named to manage the Indianapolis Operations for that division. In addition, in December, 1973 Don was named General Manager of the newly created G.M. Transportation Systems Division in Warren, Mich. Don served on the technical staff at the M.I.T. Instrumentation Laboratory. He joined G.M. in 1959 as an associate director of the Boston R & D lab of the A.C. Electronics Division (now Delco Electronics Division). He became director in 1961. A year later he was transferred to

A.C.'s Milwaukee facility as director of engineering and sales. He was named director of operations in 1968.

Al Carr completed course requirements in December, 1973, passed comprehensives in January, 1974, and was awarded an M.B.A. in late May 1974 from Loyola College in Baltimore. . . . **Donald Davidson White** is working for the Environmental Protection Agency in Dallas as an urban planner. Don's evenings are spent in scouting as Cub Commissioner. Don received the District Award of Merit in Scouting this year. . . . **Albert J. Davidson** is completing 12 years at Grumman Aerospace Corp. in Bethpage, N.Y. where he is employed as a structures engineer-computer programmer. Rheba and Al's principal concern in addition to surviving during this period of rampant inflation and keeping the house from disintegrating around their heads, is trying to find a way to put three children through college in the space of eight years on an engineer's salary. Their son, Joel, talks of going to Tech in 4½ years, and this just helps to complicate the financial problem. Is there any sage advice from someone who has faced this situation?

Perry Nies is executive vice-president of Fourdee Inc., Casselberry, Fla. His company manufactures military electronic equipment, mine detectors, beacons, and P.A. sets. Annual sales are \$6,000,000 and their foreign business is expanding. Perry had to give up sailing and has a stink pot for inland rivers. . . . **Ed Mack** is still working at J.G. Milligan Company in Milwaukee as a product development chemist on latex adhesives. His son, Eddie, is in the second grade.

G. Richard Worrell is manager of simulation and analysis, Research & Engineering Department, ARCO Chemical Co., Division of Atlantic Richfield Co. He was recently appointed environmental protection coordinator for the Chemical Division. . . . **John W. Herbert** is president of Seacon Research, Inc. . . . **Harry H. Meyer, Jr.** is thoroughly enjoying his work as senior vice-president of Cherry Electrical Products — a privately held manufacturer of switches and allied components in Waukegan, Ill. — **S. Martin Billett**, Secretary, 16 Greenwood Ave., Barrington, R.I. 02806

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Walt Hylander reports that he retired from the Army in December, 1973. He is now construction training and development supervisor for Bechtel Power Corp.'s 2500 megawatt Grand Gulf Nuclear Station project in Port Gibson, Miss. . . . **Paul Kruger** is on leave from Stanford University as director, advanced geothermal energy research and technology, RANN program, National Science Foundation, Washington, D.C. . . . **Charles R. Faulders** is now in charge of energy systems studies at Rockwell International's Space Division, and hopes to find ways to apply aerospace technology to new approaches to solving energy problems of the nation. Charles says that *Technology Review* is an excellent source of information on this subject.

James J. Bennett announces that he is currently president and group executive of Leisure Products Companies, U.S. Industries. His oldest daughter, Carol, is a senior at the University of Michigan; his son, a

freshman at Western Illinois University. Jim hopes to attend the 25th next June. . . . **Alfred Gallucci**, president, Grasso Construction Co., is now operating a landfill for the City of Shelton, Conn., and an asphalt mixing plant. Also, they are attempting to locate the first dog racing track in the state in Shelton — his first experience was at Revere, while at Tech, in 1947. — **John T. McKenna, Jr.**, Secretary, 2 Francis Kelley Rd., Bedford, Mass. 01730

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Dear '53-ers: Hooray! I finally got some mail (albeit limited) from a few of you. Please don't stop while we are ahead. . . . **Robert Goebel** (a Captain) notes that he is now Chief of the Engineering Division, Seventh Coast Guard District in Miami, Fla. [Tough break on your location, Robert.] . . . **James Wynne** has been elected to the Honor Squadron, American Power Boat Association for his contributions to the design of pleasure craft and boat racing activities. . . . **Rocco Mancini** (whom I saw in January at the annual Transportation Research Board meeting in D.C.) notes that he recently was promoted to New England Regional Manager for the firm of Tippetts-Abbott-McCarthy-Stratton (T.A.M.S.), a firm of engineers and consultants headquartered in New York; previously, he served as project manager in their Chestnut-Hill, Mass. office. . . . After many years with Comision Nacional de Fomento, **Fernando Blanc** left his native Cuba (already under Castro red regime) in 1964. He worked on the erection of a process plant in Spain, then arrived in the U.S. in 1965, working for F.M.C. at Princeton until 1969. After many years of "heavy snow shoveling" in Grand Island, N.Y. (Hooker Chemicals), he is back in New Jersey with a consulting engineering corporation. He ended with a note, "Married to Maria in Cuba. No children."

In December, a major government-industry seminar took place in Washington (with the joint sponsorship of the U.S. Department of Commerce and the Industrial Research Institute, the latter of which was founded under the auspices of the National Research Council) on the proposed massive national effort to achieve self-sufficiency in energy resources. Our good ole "Elephant-type" classmate, **Bill Gouse** (now, and still, director of R. & D. for the U.S. Department of Interior), was one of the speakers on the program. . . . The Institute of Electrical and Electronics Engineers recently announced its elected officers for 1975-76; among them were **Robert Rivers** who was elected as one of three divisional directors. . . . **Charles Homsy** writes that "the top news this year was the introduction of Proplast^(R) (the first material specifically designed for human implantation) to the medical community. Proplast^(R) was invented in my laboratory at the Methodist Hospital and is manufactured by my company, Vitek, Inc." It should be added that considerable publicity has been given to Chuck's invention, all of which is too lengthy to report here. However, I will add that he is also Assistant Professor in Orthopedic Surgery at Baylor College of Medicine and a chemical engineer with a background in polymer research. [I hate to dig up old news, but guess who used to be engaged to guess who's sister-in-law?] . . . That's all

folks. See you in Pittsburgh, or at the tables in Vegas, or on the beaches in St. Thomas. Or somewhere. Or, even get a letter on your whereabouts and/or doings. — **Martin Wohl**, Secretary, 7520 Carriage Lane, Pittsburgh, Penn. 15221

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John Griffiths, chief of the radio propagation branch of the Air Force Technical Applications Center, Patrick A.F.B. has been selected for promotion to "full bird." . . . Another U.S.A.F. Lt. Col., **Art Sargent**, is now serving at Ramstein Airbase, Germany, as an air operations officer. . . . **R. Clif Duncan**, an officer of Polaroid Corp. for the past six years, was recently named as a member of the Charles Stark Draper Lab., Inc. Members of this non-profit corporation hold the assets in public trust and elect the corporation's directors.

Another Polaroid luminary, **Dean Jacoby**, passed along the following news on the **Al Wards** and **Roy Riedingers** as gleaned from Christmas cards. Al and Jane Ward have finally reported in from California where rumor had it that they had moved, but the report contained precious little news. They have seen Jan and **Coley Bresee** and live in the San Francisco area. Debbie and **Roy Riedinger** had quite an eventful 1974. The main event was an African safari en famille — that is with ten-year-old Guy and nine-year-old Chip. They were in the bush 23 days and returned very enthusiastic about big game and Africa. Roy has moved into a new job and new function for Proctor and Gamble — research and planning for long term raw materials requirements. . . . Where is YOUR Christmas news? Send it along to — **Dave Howes**, Box 66, Carlisle, Mass., 01741; **Chuck Masison**, 76 Spellman Rd., Westwood, Mass. 02090; **Lou Mahoney**, 14 Danby Rd., Stoneham, Mass.

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Ashton C. Stocker has been appointed vice president of operations of Winchester Electronics, a Connecticut manufacturer of connector components and systems. In this position he has management responsibility for all manufacturing and material functions. Previously he was the vice president of operations for Instrumentation Laboratory, Inc. in Lexington, Mass.

In May 1972, **Marc Gross** left his former firm and began a sole practice in patent law. At the beginning of last year he became a partner in the New York law firm of Hubbell, Cohen, and Stiefel. He has subsequently spent a lot of time in Los Angeles and Minneapolis in connection with anti-trust proceedings. . . . After a year of consulting, **Antony W. Merz** is working for Aerophysics Research Corp. in Mountain View, Calif. He is enjoying his work in the technical areas of maritime collision avoidance and optimal airfoil design.

Dick Rush is presently a master mechanic at the Burns Harbor Plant of Bethlehem Steel. He is responsible for mechanical maintenance in the steelmaking, continuous casting and slabbing mill areas. His oldest son is a freshman at Georgia Tech. I get the impression from Dick that his younger son, who is bright, may come North for his education. Dick spends his leisure time flying,

giving flight instructions, golfing, and working with Boy Scouts and the Civil Air Patrol. . . . In addition to her position as attorney for Consolidated Edison Co. in New York City, **Joyce Davis** is also an adjunct associate professor of civil engineering at City College (C.U.N.Y.). She is teaching a course in radiological health engineering. Joyce is also a member of the M.I.T. Educational Council of Westchester County. . . . **David J. Bemays** is presently a staff engineer at Automatic Radio, in Melrose, Mass. He obtained his M.B.A. from Northeastern University in 1969. . . . In October 1974, **Peter W. Chen** received the Raymond C. Reese Award for the American Society of Civil Engineers. . . . **Leonard R. Sugerman** has been reappointed to the guidance and control panel of the N.A.T.O. Advisory Group for Aerospace Research and Development.

Dick Schwind reports that he and his wife Janet are living near Saratoga, Calif. in the house they designed and built. They have two children, Kelsey and Kirsten. Dick is carrying out experimental aerodynamic and fluid dynamic research in more ways than one. He has explored 1700 miles of rivers in southern Oregon and California, and written and published the book, *West Coast River Touring*. (The distributor is the Touchstone Press, Beaverton, Oregon.) . . . **Marty Gilvar**, his wife Meg and their three children are enjoying life on their 52 acre farm in rural Oakham, Mass., after struggling for two years with the house. Marty reports that his farmhouse is historic not for having been built in 1762, but for being the first house in the Commonwealth to be condemned.

A number of classmates have remarked that they will be coming to our 20th Reunion on Martha's Vineyard, June 6-8. **Bill Friedman**, **Lester Lee**, and **Dick Rush** intend to be there, so why don't you mark it on your calendar, too. — **Allan C. Schell**, Secretary, 19 Wedgemere Ave., Winchester, Mass. 01890

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Tom Doherty is back in Toronto after spending three years designing theater stage sets. He is now working with Arthur Erickson, a well known architect. . . . **Chuck Gorman** has joined Dexter Corp. as director of purchases of the Windsor, Conn. and Churnside, Scotland plants. Chuck had previously worked for Rogers Corp. . . . **John Gregory** has become national sales manager for Instrumentation Engineering Inc. of Franklin Lakes, N.J. . . . **James Moseley** has become medical director of Northfield-Mt. Hermon School, Northfield, Mass. . . . **Larry Moss** remains as executive secretary of the Committee on Public Engineering at the National Academy of Sciences. He is now also Chairman, Federal Energy Administration Environmental Advisory Committee and Director, Resources for the Future. Thus, he continues his efforts as an environmental spokesman. . . . **John Patierno** attended the Harvard advanced management program in 1973 and returned to Northrup as deputy program manager of the F17 fighter program. . . . **Ed Pease** has been elected to the board of the Martha Graham Center for Contemporary Dance in New York. . . . **Eric Schonblom** is assistant professor of engineering at the University of Tennessee. . . . **Regis Schultis** writes that, in the midst of Wall Street's travails, he is now a first vice

president of Smith, Barney. — Cosceteraries: **Bruce B. Bredehoff**, Box, 181, Dover, Mass. 02030; **Mrs. Lloyd Gilson**, 35 Partridge Road, Lexington, Mass. 02173

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There is much news to report this month. As mentioned earlier Betty and I, aided by **Mike Brenner**, hosted a cocktail party for New York area classmates on January 17 and more than 30 people showed up. A "requirement" for admission was the provision of some news suitable for printing in *Technology Review* and most everybody complied. Following drinks, a large number of us walked to a local Chinese restaurant. I believe it was much fun and hope to be able to hold another such gathering prior to our 20th Reunion in 1977. If any of you in other areas are interested in meeting with local classmates and need assistance with address lists, etc., please let me know. I'll be glad to help out. With everyone dropping in a buck or so, it need not be a big expense; you'll be amazed at how many old friendships are rekindled and new ones made. Here is some of the news received. (More news plus, hopefully, some photos will appear in subsequent issues)

Donald Levitin received his B. Arch. Degree in 1967, and, subsequently, N.C.A.R.B. Certification. He opened his own office in 1969 and designed several small but very interesting projects. His practice consists, to a large extent, of design consulting to other architectural and engineering firms. Residential expression has been an important aspect of his work, but other facets include planning operation centers for power companies, office towers and industrial plants, a small airport facility for the New York metropolitan area and several middle density housing communities. In addition to his architectural practice, Don is also a serious contemporary painter with two one-man shows to his credit at this time. . . . **Herb Schwartz's** note read: "I married Gail Lubets of Brookline, Mass. in 1960. We have three children: Wendy, ten, Karen, seven, Peter, five, and live in Cos Cob, Conn. I received an M.A. in economics and LL.B. from the University of Pennsylvania in 1964. I have been with the law firm of Fish & Neave in New York since that time, where I am now a senior partner. We specialize in litigation, including patent and trademark matters. I am active in sailboat racing. I currently sail an Ensign and am part of a syndicate having a larger racing boat (1/2 tonner) built. I am commodore of our local sailing organization (Greenwich Cove Racing Association) and regional commodore of the Ensign Class Association for this region."

Herb Heller contributed the following: "I'm working for General Foods in White Plains, N.Y. My responsibilities are in the new business area and include identification, development and test marketing of large, new-to-G.F. grocery business opportunities. It's challenging and exciting work and I like it. I've been with G.F. for the past nine years working in various marketing and new product areas. Prior to that, I worked with some small packaged goods companies including an unprofitable (financially, that is) venture in which I had a part interest. I am married to Naomi Tandet with two children (Richard, age 13 and Erica, age ten). Live happily in the woods of North Stanford,

Conn. After doing an admirable job of raising the children to the point at which they can find their way home safely from school, Naomi has ventured out on her own and opened a full service travel agency (Prospect Travel, Stanford, Conn. 203-325-4301 — all business welcome — we need it.")

And from **Jerry Collen's** sweet wife: "After a short but very enjoyable stay in Wilbraham, Mass., the Collen's have settled once again in their native New Jersey. Jerry is the President of Micro Check, a company in the microfilm and photo-identification business. The three Collen children have the good fortune to have inherited their father's tallness (remember — 6'7") and their mother's good looks (thank heaven!)"

Jordan Gruzen (one of the three architects at the party) provided the following notes: "As chief executive of Gruzen & Partners I have, for the last several years, been directing architectural activities in our New York and New Jersey offices. Our most well known recent projects have been the New York City Police Headquarters, in which my partner, Peter Samton, '57, and I collaborated. This work was written up in *New York* magazine. We are also designing the new \$55,000,000 York College in Queens for the City University of New York. I took a trip to Moscow last year for the State Department since we are designing the new U.S. Embassy in Moscow, which is a ten-acre compound of offices, housing and recreational facilities. In addition to the four partners who are M.I.T. graduates, two architects on our staff are from M.I.T. and two of our women architects went to M.I.T. last September for their master's degrees. **Fred Morefield** did not ask my permission when he moved into the upper West Side since this is *my turf*, where I have been living for the last ten years. However, I think he will be an acceptable neighbor."

That's all for the party crowd for this month. From the mail bag comes a note from **John Psarouthakis**. John has been appointed group vice president for foreign operations and international corporate development for Masco Corp. Masco manufactures faucets, air moving equipment and other specialty products for the home and recreation markets, and cold extruded and other precision industrial components for several industries. Manufacturing takes place in the U.S.A., Canada, Denmark, Germany, Italy, and Australia.

A very sad note this month is the news that **Jim Chorak** has died suddenly, in Brazil. I don't have much information except for a copy of a letter that Dick Knight of the Alumni Association sent to Jim's wife. It read in part as follows: "I was indeed sorry to learn from Bill Hecht of Jim's sudden death on November 29, 1974. On behalf of the M.I.T. Alumni Association may I offer my condolences. Those who knew him best, his classmates, will be notified by means of *Technology Review*. The invaluable time and energy Jim gave in service to the Institute were deeply appreciated and will be sorely missed. Up until his untimely death he was actively organizing innumerable plans, arrangements and details with key Brazilian leaders and alumni for an upcoming visit by Alumni President Luis A. Ferre and Sloan School Dean William F. Pounds to Rio de Janeiro. This service, loyalty and continued interest in the affairs of M.I.T. have placed him high in the admiration of

those associated with him through alumni activities." I've dropped Jim's wife a note on behalf of the class. Any of you wishing to contact her can reach her, I believe, at the following address: Mrs. James M. Chorak, c/o John E. Gibson, 241 So. Anita Avenue, Los Angeles, Calif. 90049.

Finally, before signing off, a note that I left Mobil early in January (after ten years) to join American Independent Oil Company, a subsidiary of R. J. Reynolds Industries (tobacco, food products, Sea-Land, etc.) as Vice President of Finance and Treasurer. My new office is at 50 Rockefeller Plaza. The telephone will be (212) 977-8655. Please call or drop in anytime. — **Fred L. Morefield**, Secretary, 285 Riverside Drive, New York, N.Y., 10025

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Living the not-so-quiet life on Nantucket are **Carl Borchert** and his family. While Karen teaches first grade, Carl does carpentry, some land-use planning and some engineering with Joe Yacus, '59, a former roommate. Carl also reports seeing **Nick Latham** quite frequently. . . . **John Boynton** has departed from N.A.S.A. and is self-employed as a consulting engineer. He is "working on a novel and submitting material as a free-lance writer and enjoying life in general. Recently bought a used trimaran sailboat and fixed it up." . . . **Dick Procnunier** is now working for the Environmental Protection Agency as a regional noise representative (we don't know whether he is making it or stopping it, however).

Sheldon Dean is now supervising the corrosion group of Olin Metals Research Laboratory in New Haven and is engaged in metal finishing and electro-chemical research. He received the A.S.T.M. Certificate of Appreciation for work performed in this research area in May, '74. . . . Roy Scarpato, '60, is now manager of engineering for Honeywell's Microswitch Division and reports that "my spare time is fully occupied with my wife, four children, a dog and a cat, and extensive pro-life activities." . . . Stephen Newman, '56, is practicing urology in Saint Petersburg where he is chief of staff at Lake Seminole Hospital. After three boys, Stephen and Pamela finally got it together with a daughter, just recently arrived. . . . **Allan Bergman** has been promoted to marketing manager, Packaging and Converting Department at the National Starch and Chemical Corp. . . . **Robert Steele** received a Ph.D. in Chemistry from Berkeley in '72 and has since been at United Aircraft Research Laboratories doing research on chemical lasers.

Ronald Neece is a professor of civil engineering at the University of Washington and is co-chairman of the 1975 A.S.C.E. Hydraulics Division Specialty Conference. . . . **Mac Jordan** was recently promoted to the position of executive assistant to the executive vice president of Kerr-McGee Corp. . . . **David Vahlsing** is manager of process design in the control engineering department of Sun Oil Co. Currently he notes that he is "serving as president of the Philadelphia Inter-Club Squash Racquets Association, as well as keeping busy with our two-year-old son — an unexpected arrival after 15 years of marriage." . . . **Dan Brand** has been named Chairman, Pas-

senger Travel Demand Forecasting Committee, Transportation Research Board, National Academy of Sciences. He has also been designated as a member of the Policy Advisory Committee of the Boston Metropolitan Area's Joint Regional Transportation Committee.

For Boston area classmates, we have a mini-reunion plan on the launch pad; watch this column or your local mailbox for later news. Our tentative plan is for cocktails and buffet dinner here at my townhouse in the South End of Boston, and then go to the Pops concert . . . — **Michael E. Brose**, Secretary, 30 Dartmouth Street, Boston, Mass. 02116

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A note from **D. Montgomery Wells**: "Still teaching chemistry at Newton North High School. My daughter is in first grade. My wife — after jobs as insurance actuary, math aid at Lincoln Lab, computer programmer at Aerospace Systems, Inc., and jewelry salesperson, is now organizing the service program for Allen Pen Co. of Newton. In my spare time I still read science fiction and race sports cars." . . . In February, **N. Eric Jorgensen** celebrated his second anniversary with Tektronix as the assistant general counsel and assistant corporate secretary. He has phased out his private law practice in Oakland, Calif. over the past two years and looks forward to having time for skiing and other recreational opportunities as a new Oregonian. . . . **Susan E. Schur** was selected as one of the Outstanding Young Women of America in 1974.

From **David H. Geisler**: "I have been assigned responsibility in the manufacture of a new DuPont fiber — Kevlar[®] which is being used from aerospace to tire reinforcing — truly a miracle fiber — an exciting experience to participate in." . . . **Harold Levy** writes: "Economic necessity forced a staff reduction at Searle Medidactor, leaving the company better adapted to a temporarily reduced market, and leaving me as manager of computer programming for the automated multiphasic health testing and hospital information systems product lines." . . . Since April, 1974, **Varadachari A. Sadagopan** has accepted additional responsibilities as the manager of university and scientific relations for I.B.M. Research Division. . . . **Bob Walsh** writes: "We have moved to the Chicago area from Boston. Wife and children are settling into their new home and school. Angela is working at Evanston Hospital in the CCU and ICU and I am the patent counsel for Bell and Howell Business Equipment Group. If any of my classmates are in the Chicago area, please give me a call."

Morris Salame is currently manager of container research and development at Monsanto Co., working on the new highbarrier "cycle-safe" container to be used by food and beverage packagers. He recently completed an environmental seminar at R.P.I. on packaging. . . . **Thomas Wallace Alexander** received an M.A. degree in mathematics in December, 1968, from the University of California at Irvine, and an M.S. degree in engineering in January, 1974, from California State University at Fullerton. . . . **Ray Gumb** is an associate

professor of computer and information sciences at Temple University. . . . **Ronald D. Agronin** writes: "In October I was named manager of impregnating and chemical operations for Kimberly Clark's Paper Division. It is a complete change from my previous job and has been quite a challenge. This year I was also elected board chairman of our synagogue and have been quite busy as an M.I.T. education counselor. We have had six applicants to M.I.T. from my area — a record high." . . . From **Charles E. McCallum**: "I have been elected president of the Greater Grand Rapids Chamber of Commerce for 1975. Still in active practice of law as a partner in a 40-man firm in Grand Rapids. I live with my new bride, JoAnn, in suburban Cascade." . . . **Robert L. Mullen** is now systems manager for Cerro Wire and Cable Co. of New Haven, Conn., although he is still living in Massachusetts.

Howard L. Elman writes: "1974 was a very momentous year for me. The primary news is I caught the most gorgeous angel ever born (if this letter gets a bit much, we just got back from our honeymoon. . . .) Joan Carter is a tall, extremely slim, blue-eyed, golden haired, intelligent, sweet flutist. She will continue to use her maiden name as her stage name. She presently plays in three orchestras, and has made a number of recordings. To add a bit of Old School Nostalgia, her grandfather (Donald Carter) is a Tech Alumnus, '21. I have been pursuing Joan for about a year and a half — met her at the swimming pool of my apartment complex (we were neighbors.) Since meeting her I have become a physical fitness buff; we jog, and our honeymoon was a ski trip. Her other talents include ballet and interior decorating. She is quite a cook, can mix a drink well, and has played jazz flute on the side. What more can any sane man ask?"

"1974 also saw me promoted in the reserves (major). Of course '74 would be normal for that point for a reservist, but I got mine six months early. . . . Uncle Sam apparently thinks I am Superman or something. You can all sleep well tonight (it is the night I am *not* on duty).

"At the Bradley Air Museum/Conn. Aeronautical Historical Assoc. (I always get a free plug in for that as you know) I was promoted from vice president to executive vice president in early 1974. Our collection now is over 100 aircraft with 1/3 to 1/2 on display at any one time. Still living in Connecticut; still working at Kaman Aerospace (helicopters); still glad to offer a drink to any '60 who drops by.

"Other news: Got to visit with **Bob Walsh** quite a bit before he left Boston. And a number of Tech men from adjoining classes have been heard from of late as the Pershing Rifles unit at Tech tries to locate Alumni — I went to their initiation, and heartily recommend support."

Sheldon Epstein is senior patent attorney, Recreation Group, Brunswick Corp., in Skokie, Ill. . . . **David A. Willis** is now supervising engineer in the process engineering division of the Pascagoula, Miss. Standard Oil Refinery. Mr. Willis has completed a two-year loan assignment with National Iranian Oil Co., one of Standard's foreign affiliates. He and his wife and five children live in Pascagoula.

John S. White died on October 5, 1974. The sympathy of the class is extended to his family. — M. L.

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Only a couple of notes came in the mail this month. Working on them from right to left (or east to west) I start with the class representative at Philbrick Associates, **Bob Pease**. Bob writes: "I have been expanding our line of Voltage-to-frequency converters with new units up to 5Mhz down to \$19 and as good as 3 PPM/C° with as little as 0.005% nonlinearity. Lots of fun." . . . **Seymour Cromwell** says that he is still teaching math at the Groton School. . . . Further south, in Bethesda, Md. comes word from **Henry Gabelnick** who wrote: "I'm starting a new job this month [December]. Although still at the N.I.H. I'll still be working on contraceptives (developing — not testing). My wife, Faith received her Ph.D. last spring and is on the faculty of American University."

Moving on to the midwest, **Tom Clevenger** wrote, stating that: "I'm now responsible for Owen's Illinois' operations and investments in the Far East/Pacific region. I still have the job of vice president, Technical Director in addition for the International Division." . . . **Robert Goldthwaite** is in Milwaukee, "the beer capital of the world," working for the Miller Brewing Co. as a senior development engineer. The Goldthwaite's fifth child [no sex indicated] was born in their home town of Oconomowoc, Wisc. Prosit, Bob. Another blessed event transpired September in the **Roger Whitman's** local hospital. Theora Whitman produced Michelle Lynn Whitman. Michelle has an older brother, Randall, who is nearly five. . . . Finally **Pete Gaposkin** reports that he is "now employed as a physicist at the naval plant representative office in Sunnyvale, Calif. I hope, someday, to become a computer programmer." — **Andrew Braun**, 464 Heath Street, Chestnut Hill, Mass. 02167

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George Edward Sinclair has switched from college teaching to become a missile scientist and has moved to California. Joy and he have a new son to even the score (two boys, two girls). The eldest entered kindergarten this fall. This summer, Dr. Parkin Lippincott (VIII, '61, Ph.D. '64), Sharon, and their youngsters visited with the Sinclairs on the way to Disneyland. They were pleased to see them again. . . . **Frank Rubin** in the past 18 months has delivered two papers to the Design Automation Workshop, had one paper on printed circuit boards in I.E.E.E. Transactions on computers, one on graph planarity to be published shortly, one on Hamilton paths in J.A.C.M., and six others accepted, including one for American Math Monthly. . . . **Rurik B. Halaby** is now vice president-corporate finance with Hornblower-Weeks-Hemphill, Nyes, Inc. in New York. He is living in Ridgewood, N.J. with his wife, Cynthia and sons Michael (8½) and Nicholas (seven). Even though he is a registered Republican, he has been active in the campaign of Congressman-Elect Andrew Maguire (D-7th Cong. District. . . . **Theodore J. Sheskin** received a Ph.D. in August 1974 in Industrial Engineering and Operations Research from Penn State University. He is an assistant professor of industrial engineering at Cleveland State University in downtown Cleveland. Cleveland

State is an urban university serving commuting students, many of whom hold full-time or part-time jobs. . . . **Harold M. Waller** retired in June as chairman of the Department of Political Science at McGill University. At present he is spending a sabbatical year in Washington, D.C., conducting research on energy policy. . . . **Richard Queeney** is still at Penn State University as associate professor of engineering science and mechanics. In his spare time, he has become a weekend beekeeper, producing enough honey to replace a good part of his family's sugar and to sell to the local population. He tells us that with a name like his, the operation's name is a natural; Queeney's Bees! . . . **Stephen Phinney** let us know that he is living in Manassas, Va., and that his father (Robert M. Phinney, '04) is living near them. He is getting the care and therapy he needs to develop strength to walk and he has just celebrated his 92nd birthday. He tells us that his father is an avid reader and is interested in the latest on his classmates. . . . **Elliott Bayly** is living in Oak Creek near some fine skiing and would love to see anyone coming through. — **Gerald L. Katell**, Secretary, 7 Silverbit Lane, Rolling Hills Estates, Calif. 90274

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January 1975. Your peripatetic class secretary just returned from a two week trip to Japan to find an overdue class notes deadline and a bumper crop of information for publication in this space. I'll space out this material over two months, so if your note doesn't appear in this issue, it will be in the next one.

To begin with I'll give you some personal history, and explain all these trips to Japan I've been making. For the past four years I have been research and development director of Nucleonic Data Systems, of Irvine, Calif. Our company is in the gauging and process control business, dealing primarily with the steel, rubber and plastics industries. We build thickness gauges using "nuclear" and optical techniques and design computer control systems around the gauges. Recently I've been working on two projects for the rubber industry — one relating to the measurement of steel cord tire belts and the other dealing with control of the tire tread extrusion process. A number of Japanese companies have shown interest in this work and we are pursuing several joint development projects with Japanese firms. I've made three trips to Tokyo in the last year and more are scheduled for the coming months. On the home front, my wife Barbara received a masters degree in clinical psychology from the University of California at Irvine, and this December began a job as administrative assistant to the Dean of Students at U.C.I. My two daughters are growing like weeds — Amy, nine, is in the fourth grade, and Laura, six, is in the first grade. Well, enough tooting my own horn, now let me toot some of yours.

I received a Christmas card from Austria from **Marty Schrage**. Marty is now back at C.S.P.I. in Boston as director of international sales. . . . **Floyd Stecker** wrote to say that he received the Medal for Exceptional Scientific Achievement from N.A.S.A. last October. . . . **Dave Caskey's** note said that though he has written several times for

Tech Review none of the information has appeared. Sometimes even our able friends at the *Review* make mistakes, and your previous notes may have gotten in with those of another class. Why not write to me directly — Albuquerque to Irvine is a lot shorter route than Albuquerque-Boston-Irvine, and we'll eliminate the middle man. I guarantee you'll get into print. . . . **John Brach** sees many M.I.T. alumni and classmates in Atlanta. The Rapid Transit Authority for which John is East Line Manager is now under contract with many consulting engineering firms and it is through this association that he has most contact with friends from M.I.T. . . . **Rick Merrill** reports that he and his wife Marge are the proud parents of a baby boy, John Hammond Merrill, born August 7. Their four-year-old tries hard to get along with the new addition to the family.

Another new baby is reported by Jan and **Jack Solomon**, this one, a daughter, Alyssa Joy, was born March 17. The Solomon's other daughter, Sheri, is 14. Jack has a new position as senior project engineer in the Gas Products Development Lab, Linde Division, Tarrytown Technical Center, Union Carbide Corp. He notes parenthetically that last year he couldn't spell engineer and now he are one. (Bad joke.) . . . **James Tang** writes that he has been living on Guam for the past 3½ years. Jim is the president of two Guam-based companies, Guam Capitol Investment Corp. and Nimitz Hill Assoc. . . . **John Flaherty** has joined the faculty at the Johns Hopkins School of Medicine as an assistant professor in the Department of Medicine. Cardiology is his subspecialty and his time will be divided between research, teaching, and patient care. John's three sons are now ten, six, and four. His wife Lois is in private practice in child psychiatry. . . . An anonymous classmate (no name on the envelope flap) reports that **Phil Marcus** is now a lawyer in Baltimore. Say folks, if you do take the trouble of filling out one of those envelope flaps please write your name on the class news side along with your note — I'd like to be able to give credit where it's due.

Press releases: **Jim Champy**, former class president, has been appointed executive vice president of the M.I.T. Alumni Association, effective Jan. 1, 1975. Jim received B.S. and M.S. degrees in civil engineering, and the L.L.B. degree from Boston College Law School, and practiced corporate law in Lawrence, Mass. and Cambridge. He has been a member of the M.I.T. Corporation since 1969 and has served on several M.I.T. committees. The appointment was announced by Luis A. Ferre, president of the Alumni Association. Jim will now be serving the Institute full time.

A 22-claim patent has been issued to **Kenan Sahin** for a computer network named for his wife. The system eliminates the need for a central router or switchboard. A user can interrogate an entire network without identifying his computer's address or those of the potential response sources. Dr. Sahin's work on the invention began at M.I.T. and was completed at U. Mass where he is now associate professor of business administration. His wife is also on the U. Mass faculty. The Sahins have two sons and live in Amherst. . . . That's the news for this month. More to follow. — **Mike Bertin**, Secretary, 18022 Gillman St., Irvine, Calif. 92664

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Shalom '64. Here I am, three days late again and just beginning my first draft. Deadline notices come at least two weeks in advance; I just don't understand what happens every month. **Ron (Gilman)**, please write and let me know how you did it, for TEN years, no less.

Let's start out with our Class Hero of the month, **Gary Walpert**. Gary is practicing patent law with the law firm of Fish and Neave in New York City, and he has become a member of the New York Bar. Ellen received her J.D. degree from Boston University Law School, but she spends most of her time caring for their daughter, Tara Ellen, who was born on 22 September 1973. Gary and Ellen have purchased a new condominium in Tarrytown, New York; and, hopefully, they will be all moved in by the time you read this. I say hopefully because when we last spoke to them, they were experiencing what seems to be the inevitable delays and irritations that confront all of us who purchase our new homes while they are still under construction.

Now to the class notes: **Richard Adamec** writes that his son Aaron has just enjoyed his first Christmas. He also informed us that he is leading his division in a recent sales contest for divisional sales managers. . . . Still teaching Army R.O.T.C. at the University of Washington is **Joseph Boling**. . . . **Edward Casper** has "switched from Nail Polish at Cheeseborough-Pond's to Cough Medicine and Toiletries at Vick". He also has now earned his green belt in Karate. . . . **Baldassare Di Bartolo** directed a N.A.T.O. Advanced Study Institute on "Optical Properties of Ions in Solids" in Italy last June.

St. Croix, Virgin Islands is home to **Eugene Grumer**. He is now manager of operations planning and economics at the Hess Oil Virgin Islands Corp. . . . **Leon Kaatz** is halfway thru the University of Connecticut Law School and expects to graduate in May, 1976. Juvenile Law is what he'd like to specialize in some where in southern New England. . . . **Carole Lubin** is working for Honeywell Medical Systems Center as a Medical Systems Analyst in Houston. Best wishes to Carole — she's getting married this coming June. . . . **Robert Popadic** and his wife Karen are enjoying parenthood for the first time. Congratulations on the birth of their new daughter Anne.

When last I wrote, we were enjoying the sunny December environment provided by Fort Lauderdale, Fla. Thax to Christmas-time airline rates combined with having both children over two years old now, we decided to try it by car. We left at 6 A.M. on Friday the 13th (December 1974), of all days. After leisurely stops in Connecticut (breakfast), Emporia, Va. (supper), and Fayetteville, N.C. (dessert for kids at Hojo's), we somehow never stopped again (except for gas), only talked about doing it. Lo and behold, we arrived at Ocala, Fla. at 6:30 A.M., December 14, EXHAUSTED but glad to have the trip (!1350 miles) behind us. After a very pleasant visit with a great aunt of mine whom I hadn't seen in 22 years, we moved on to Disneyworld (Mickey country, if you ask my kids). There we spent three fun-filled, rainy, and (of course) expensive days, staying in the Contemporary Towers. At the park it was primarily "Dumbo" or the

"flying horses" (carousels), though we did interest our children (ages five and 2½) in "Country Bear Jamboree" and "Mickey Mouse Revue." Rides in the dark did not go over well during this visit. Fortunately for Marlene and me, the "teacups" (Oh! Indigestion — Mad Hatter's Tea Party) was closed for renovation, repair, enlargement, or something like that. George (the five-year-old) and I got to preview the new "Space Mountain" ride, a roller coaster through the galaxy — quite an exciting ride! As all good things must come to an end, so did our visit to Disneyworld, much to the dismay of two small children but somewhat to the relief (delight?) of two tired parents. Now we could get on with our part of the vacation (rest, basically) — Fort Lauderdale — where loving grandparents anxiously awaited our arrival — especially that of their grandchildren. That's all for now. Please write. — **Steve Schlosser**, Secretary, 15 Apple Hill Road, Peabody, Mass., 01960

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An anonymous letter appeared in my mail last month reporting that "Ed Yourdon spent 1974 getting married for the third time to his first wife and therefore, also his third wife; completing his third book on the marvels of structured programming for Prentice-Hall, starting fourth and fifth books in the computer area; climbing trees with his four-year-old daughter; and starting a computer consulting firm. Brilliantly named YOURDON, Inc., the company is raking in money while Yourdon overworks his staff and travels extensively throughout Eastern and Western Europe, Canada, Australia, etc. with his several Nikons around his neck and his electric typewriter strapped to his back, generally making a nuisance of himself. He has managed to become more insane, increasingly anti-social, and more of a prankster than he was at M.I.T." My anonymous correspondent who disavows any connection with M.I.T., says he understands that this, for an M.I.T. graduate, means that he has finally "grown up." That is more interesting than most of the signed correspondence I get from classmates.

Linda and **Doug Spreng** are the parents of a healthy baby boy, Eric Douglas, born last November 21. Linda's letter says that the entire family is adjusting beautifully and that, despite the new addition, the Sprengs still have a guest room at their home in Santa Rosa, Calif. for those who enjoy wine tasting. . . . It took the appearance of a "MITRE Matters" in the clipping file to remind me to write of the promotion of **Ed Burke** to group leader at the MITRE Corporation. This is a bit silly, since I've known of Ed's promotion for some time (before he did?) Ed is responsible for developing a large-scale secure computer system at MITRE. Ed and Ann live in Bedford, Mass. and have a daughter, Jill, two years old. They should have another youngster before this column reaches you. . . . **Henry Lichstein** wrote to say hello and tell us that he is still at First National City Bank and having fun.

Kathy and **Art Bushkin** report two new additions — Samoyed puppies named Bridgette and Jason. . . . **Rob Silverstein** and wife Ellen still live in Washington area with their three children Seth (six), Rachel (four), and Allison (two). Rob says he occa-

sionally sees Art Best ('64) and **Bernie Nordmann**. He reports that **Mike Oppenheimer** has relocated to San Francisco. . . . **Ed Bucher** was married last April to the former Gail Phillips in Cambridge. **Jim Pearson** was the best man. Ed still works at the M.I.T. Lincoln Laboratory. . . . Susan and **George Lee** have a new daughter named Dana Elizabeth. George still works as a staff engineer for TRW Systems. . . . **Mike Keehner** reports the birth of a son, Brigham Michael, last October 14. Mike was elected a vice president of Kidder, Peabody and Company in December and a director of Inexco Oil last April. . . . and Caroline and **Dave Kettner** had a 9 pound, 2 ounce son last July 19.

Mary Coffey completed her Ph.D. in Environmental Health Sciences at the Harvard School of Public Health last June. She is still an air pollution analyst at N.U.S. Corporation and enjoying the work and the Washington area. . . . **Orville Birkestrand** founded Birkestrand, Inc. on January 1 and is engaged in the manufacturing of proprietary products for the metal working industry. . . . **Craig Wheeler** left an Assistant Professorship at Harvard last September to accept a tenured Associate Professorship at the University of Texas in Austin. Craig says that, in keeping with the American way, he has gone deeply in hock to buy an expensive house in the suburbs. Craig is teaching astronomy for poets and playing with supernovae, black holes, neutron stars, etc.

Sharon and **Dave Rubin** are still enjoying life in the new town of Columbia, Maryland. Dave is teaching cooking and working on a Master's in Administration at Johns Hopkins and on planning Maryland's airports. Sharon is teaching at the University of Maryland. . . . **Steve Maimon** has founded Interlink International, Inc., concerned with international business and economic development assistance. . . . Susie and **Dave Moran** are still in the Washington area. The big news when I had dinner with them in December was Susie's presidency at the local P.T.A. and her agitating to save Scott and Lindsay's school from being closed in an economy and consolidation drive.

We had a reunion committee meeting last night and **Jim Pepe** allowed that Intermetrics, a software firm in Cambridge is trying to hire the class. Jim has been there for a long time (four years?). **Woody Vandever** has too, and Jim says that Woody and Paula have a new baby girl named Katherine. **Don Grimes** has joined Intermetrics also. Don and wife Nancy live in Arlington.

The main news from the meeting is that the reunion looks like a success already. About 215 people are expected at the reunion (plus kids) and the response on class dues has been better than we had hoped. We have reserved part of the Museum of Science for a Saturday night dinner dance and have started plans for a Saturday afternoon picnic. The Alumni Association has made rooms available in McGregor House for out of town classmates at no charge, and that is a good deal indeed for Boston in 1975. More to follow in a second general mailing.

One final note: class officers. We got some nominations for officers in response to the class mailing and should have no trouble getting nominees for president and agent. But I'd be happier with a volunteer for Secretary and I don't volunteer. So somebody help — drop me a line. The winner

gets my annotated cross-index to Class Notes with spouses' (spice?) and childrens' names. — **Steve Lipner**, Secretary, 3703 Stearns Hill Road, Waltham, Mass. 02154

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The universe will go on expanding forever for the simple reason that there is not enough mass in the stars to pull it all back together again — so reported **Dave Schramm**, of the University of Texas, and three other astronomers in a recent issue of *Astrophysical Journal*. Almost all astronomers believe the universe was created when a superdense cloud of gas exploded into an expanding hot ball and that parts of the ball later cooled and collapsed into galaxies. A question of current debate is whether the galaxies are moving apart fast enough to escape the force of gravity. Dr. Schramm and his fellow astronomers have concluded that only one "Big Bang" created the universe and that there will be no further "Big Bangs."

Betsy and Ronald Scharlack are expecting their first child in June. Still believing in the economy, they recently bought a house. . . . **Janet Allen** and Farokh Mistree were married December 16 in Washington, Penn.; they will live in Australia. . . . **Lloyd Lewis** is a staff scientist with E.G. & G. in Waltham. . . . **John Smith** and his wife are taking harpsichord lessons. . . . **Rich Feiertag**, an instructor in electrical engineering at M.I.T., is working on his Ph.D. in computer science. . . . In order to learn about patents, **Tim Gill** is working as a patent searcher in Washington, D.C. He plans to apply for his own patents and later take a long hitchhiking vacation. . . . Renée, Justin, Nicole and **Rich Weiner** live in North Carolina where they moved after Rich obtained his M.S.E. in systems engineering from University of Pennsylvania. Rich received his M.D. and Ph.D. degrees from Duke and is now completing his first year of psychiatry residency at University of North Carolina in Chapel Hill. . . . **William Christiansen** writes: "Since I last wrote my whole life style has changed. From a happy bachelor I am now a happy husband and father. My wife, Terry, and I honeymooned in Europe, and we have a son named Brian Edward. It's amazing how great married life is." . . . **John Rible** is still working at North Shore Community College in Beverly, and he hopes to bring his interests in community, children and computers together soon. . . . **Bruce Ressler** is with the Department of Transportation in Kendall Square where he does computer work to test devices used by the aviation community to obtain weather information and file flight plans. . . . Last September **Harvey Schultz** married the former Jacqueline Gershon, a 1973 graduate of Cornell. They are living in Queens. . . . **Jeff Schoenwald** has avoided the lay-offs at Texas Instruments in Dallas, but he writes that "nothing is truly certain since God died and the dollar caved in." Jeff has changed his life style by eliminating poolside drinking parties and adding gourmet cooking. — **Jim Swanson**, Secretary, 669 Glen Road, Danville, Calif. 94526

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Greetings again from Falls Church. While

we were in Japan, some people commented that Falls Church was a strange name for a town. You therefore might wonder where the name comes from. There actually is a Falls Church in Falls Church which was built in the 18th century and was named after the rapids in the Potomac above Washington. The town was then named after the church. Now that we've had that bit of Virginia, we can get on with the news.

We have two marriage announcements and six birth announcements this month. First, **Ron Rosen** and Marilyn Parke were married last August and now live in Poughkeepsie. Ron is programming educational and medical applications for the Shared Educational Computer System. They have bought a house and welcome visits from friends. . . . Our other marriage announcement concerns Diane Hoxmeier and **Mike Rabinowitz**, who were married recently. Mike has a Ph.D. in geochemistry from U.C.L.A. and has a postdoc at N.I.H. . . . The birth announcements are as follows in alphabetical order. Nancy and **Jack Cleary** had a second child, Eric, in August. It must have been a busy summer since Jack also graduated from Harvard Law School in June and started working for the Boston law firm of Goodwin, Procter, and Hoar in September. . . . **Rick Ehrenkranz** has completed two years of pediatric training at the Yale-New Haven Hospital and is presently a research associate in the pregnancy research branch, N.I.C.H.D., N.I.H. Therefore he must have been pretty much prepared for the birth of his second son, Peter Douglas on November 30, 1974. . . . Sue and **Steve Gamer** wrote to announce the birth of Adam Robert on December 9, 1974. They are living in Middletown, R.I. Steve works in Newport where he recently met **Ralph Jennett**. . . . **Stan Hoffman** had a little catching up on news to do. He married Elizabeth An Buker, Vassar '68, on August 28, 1970 and their son, Daniel Buker, was born on November 27, 1973. Stan graduated from N.Y.U. Medical School last June and is an intern in the Baltimore City Hospitals. He plans to specialize in Dermatology in Buffalo next year. . . . From Toronto, Katherine and **Mike Krashinsky** announced the birth of their first child, Harry Allen, who was born on January 22, 1974, and is named after Mike's late father. Mike writes, "He is a constant source of excitement and joy. I am still teaching at the University of Toronto, Scarborough College and enjoying it tremendously, trying to balance the demands of students and research. We are renting a house near school (we can't afford to buy yet) and it is a joy to be in bike range of school". . . . Finally, **Ken Theriault** wrote to announce a new arrival, Seth, who was born on August 18, 1974. Ken adds, "Now I'm not pushing him, but he does have a playpen in my Building 26 office. Maybe he can come up with a Ph.D. thesis topic!"

During October and November **Kurt Gustafson** was in charge of Suez Canal clearance operations at Port Said and Port Tewfik, Egypt where five major wrecks were removed. . . . **Chris Davis** is a flight surgeon in the Air Force clinic at the Pentagon. His wife, Kathleen, is in her second year of medical school. In January they spent two weeks skiing in Colorado. . . . In June, **Paul Hyman** will complete his second year of training in internal medicine and will then start a two year program in the De-

partment of Hematology of the North Shore University Hospital as a fellow of the American Cancer Society. . . . **Richard Griggs** is working on an independent feature film as a production manager. It will be shot in 16mm on a low budget. The script is written by Richard King, who will also direct and who studied film at M.I.T. . . . From Greenwich Village, **Stephen Passage** writes that he is working as a civil engineer for the Port Authority of New York and New Jersey. . . . **Al Bernstein** is in his fifth year of teaching at the Storm King School and was recently promoted to chairman of the Science Department. . . . In November, **Reynold Martin** was promoted to Project Engineer, Flavor Department and Pilot Plant of International Flavors and Fragrances. He and his wife Rita and their daughters Jennifer and Leah are living in Toms Rivers on the Jersey Shore. They think that southern New Jersey is "a terrific place to live". . . . Despite various layoffs, **Paul Ware** is still working at Polaroid in Waltham. . . . That's all we have for now, see you next month — **Gail** and **Mike Marcus**, 2207 Reddfield Dr., Falls Church, Va. 22043

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As newly elected Secretary-Treasurer of the class of '69, I'd like to thank all those who voted for me. My two campaign pledges are 1) not to use this office as a stepping stone to the White House in '76 and 2) to publish all the news that fits arranged in alphabetical order of the class members involved.

According to material apparently copied from the book cover, **Michael Albert** has written a book entitled *What Is To Be Undone*. The tome is a modern revolutionary discussion of classical Left ideologies. Mike is now continuing graduate economic studies at U. Mass-Amherst. B.U. Prof. Howard Zinn said that the book "does an excellent job of showing the weaknesses of Classical Marxism Leninism, plus the contributions of Anarchism and Maoism. It clarifies much about the Russian and Chinese Experiences and lays a sound critical foundation for Americans to create their own revolutionary strategies."

Willard J. Basner, Jr., began working for the Medium Steam Turbine Generator Products Division of General Electric in Lynn, Mass. in March, 1974. . . . **Dino Egidio** is working in Willard's area. He also reports that he was married in August to the former Margaret Anne Christensen of Wellesley, Mass. and B.U. Margaret is working on an M.S. in psychiatric social work at Syracuse. . . . **A. C. Bell** writes that he was promoted to associate professor of mechanical engineering with tenure at S.U.N.Y. Buffalo. . . . **Charles Bures** is apparently alive, well and enjoying life with his wife Janice and two sons while working for his sixth year at Bell Telephone Labs in New Jersey.

Calvin Eng is a medical intern at the Bronx Municipal Hospital Center-Albert Einstein College of Medicine. . . . **Jonathan Frost** is with the Stanford Research Institute and works on telephone systems as a research engineer. He's been traveling frequently and working on an airplane instrument rating. . . . **Randall J. Hekman** was elected to the post of Probate-Juvenile Court Judge in Kent County, Mich. on Nov. 5, 1974. Randall had been an assistant prosecutor in Kent County (Grand Rapids),

Peter J. Hirz works for I.B.M. in Boca Raton, Fla., in charge of a test engineering group. He recently married Jane V. Stasaski who graduated from the University of Tennessee in E.E. . . . **Jeff Lepes** and his wife Layne were expecting a second child in January. Jeff spent three years in Pittsburgh and returned to Massachusetts in June, 1973 with M.S. degrees in civil engineering and industrial administration from Carnegie-Mellon. He is now a paper tube manufacturer and enjoying the challenges of a small business. . . . **Larry Lowry** earned an M.B.A. from Harvard in June, 1972, married in June, 1973, and is working for The Boston Consulting Group in Menlo Park (San Francisco), Calif. . . . **Bruce Parker** is out of the army and working for I.B.M. in Washington, D.C. He lives in Alexandria, Va.

Richard Parker is working in geochemical oceanography, beginning research in radio carbon dating and hoping to finish his Ph.D. before it finishes him. His wife Sue is in the same field and researching the identification of oil spill origination. Their two boys, ages three and six, keep them busy. . . . **John R. Smith** reports that he is still single, working on an M.B.A., and would enjoy hearing from classmates at: 21661 Brookhurst, Apt. 123, Huntington Beach, Calif. 92646. . . . **Josef Sukonick**, Ph.D. '69, has been promoted to director of new product development at CALMA Co., an interactive graphics system manufacturer.

Robert A. Swanson relates that he earned a master's degree from Sloan, joined Citicorp Venture Capital, a subsidiary of First National City Bank of N.Y., in 1970 and opened their first domestic branch office in San Francisco in June, 1973. Bob recently resigned from Citicorp to become a limited partner of Kleiner & Perkins Venture Capital in Menlo Park (Calif.). Bob also wrote: "Clyde, don't spend that five dollars; I'm still single." . . . **John L. Usher**, a former cross-country stalwart, plans to receive his Ph.D. from the University of Florida in March, 1975. John finished his degree work and is doing basic fusion research and reactor design at Brookhaven National Lab. . . . **Oakley (Lee) E. Van Slyke** has joined Booz, Allen Consulting Actuaries, in Newport Beach, as an associate actuary. Lee invites his friends to let him know their whereabouts by writing him at: 3902 Hemingway Avenue, Irvine, Calif. 92664.

Mitchell Wand is in his second year as an assistant professor of computer science at Indiana University. His daughter Rebecca was born on April 16, 1974. . . . **Edward M. Waibel**, is with the Management Services Division of Touche Ross and Co. in Washington, D.C. He's awaiting a better economic climate to launch a business venture resulting from contacts made during a business-vacation trip to Southeast Asia in 1973. . . . **Jeffrey M. Weissman** works for Rogers and Wells, a Manhattan law firm. (For the uninitiated, the "Rogers" in that firm is William P., former Secretary of State.) Jeff is still waiting to learn the results of the N.Y. Bar Exam which he took six months ago. His wife Linda was recently registered as an occupational therapist. They just took the plunge and purchased a home in New Rochelle. For the record, Ross Smith still can't tell Jeff and this writer apart.

Jeff Wieselthier has been at the Naval Surface Weapons Center (formerly Naval Ordnance Laboratory) in Silver Spring, Md.,

since graduation. He received an M.S. in E.E. from John Hopkins in May, 1971. Jeff's been working on his Ph.D. part-time at Maryland since then. He has passed his orals and is working on a thesis entitled: "The stochastic control of the rates of point processes, with extensions to differential games." He married Ilene Jacobson (U.Md. '72) in July, 1972 and they've been living happily ever after. They live in Silver Spring with their cat Vector Dipole (I swear that's what Jeff wrote in the letter). Jeff was in Israel at Reunion time.

I received a letter from **James Yankaska**. Rather than attempt to summarize Jim's activities during the past five years, I present most of his letter for your information. "I spent my first five years out of M.I.T. as an engineer for Sikorsky Aircraft. That was fun, but I couldn't see staying for the rest of my life. So the last year has seen some major changes. My wife Bonnie (Simmons College, 1967) and I bought a house in August 1973; our daughter Jill Rebecca was born on February 2, 1974; and I started medical school at the University of Connecticut this September. Bonnie is working as a research assistant and instructor at the University of Connecticut health center so we can enjoy car-pooling and lunches together. We've done a lot of flying as recreation. In addition to flying vacations to Florida and Nova Scotia, we've both taken up soaring (i.e. - flying sailplanes or gliders). Last summer Bonnie soloed in a glider (I was her instructor), and I earned the silver badge by staying aloft more than five hours, climbing more than 1000 meters, and traveling more than 50 kilometers to another airport. My next target in a sailplane is gold badge which requires a 3000 meter altitude gain and a 300 kilometer flight. In my other spare time, I've continued long distance running, and now run marathons once or twice a year. This year (1974) I finished the Boston Marathon in 2:52. That was good for 377th place, out of more than 1700 starters. I've found that running the marathon seems easier every year, even though my time has been improving steadily. It must be that experience is very valuable. While travelling to interview at medical schools last year, I stayed with our classmate **Tom White** and his wife Danny in San Francisco. Tom is in his third year of dental school at the University of California, San Francisco. He's looking forward to finishing school and settling back in sunny southern California."

On behalf of the class and the new officers, our thanks, appreciation, and congratulations on a job well done to the outgoing officers: President **Mark Mathis**, V.P. **Carl Weisse**, Sec.-Treas. **Dick Moen** and the Executive Committee: **Russ Apfel**, **Shelley Fleet**, **Mike Ginzberg**, **Peter Harris**, **Dave Jodrey**, **Maria Kivisild**, **Mike Mann**, **Frank Rogers**, **Bob Schaeffer**, **Jim Trullitt** (class agent), and **Tom Wood**. Another vote of thanks should go to the class members who live in Boston and planned the reunion. The scene as the band started playing and the cruise boat pulled away from the pier with the setting sun illuminating the Boston hi-rises was straight out of a movie. That's all for now folks. — **Peter Peckarsky**, Secretary-Treasurer, 950 25th St., N.W., Washington, D.C. 20037

Well, I missed one again, but at least I haven't forgotten about our 5th reunion. Yes, there will be one! Please reserve the weekend of June 6-8. You'll be receiving another letter soon with details about reunion plans, arrangements for guests, how much it will cost (we're trying to keep it cheap), etc. Many thanks to all of you who took the time to respond and give me your suggestions. I hope to see many of you in June.

Someone was planning to be married in January and was moving to Woonsocket, R.I., but forgot to say who he is. Could you please let me know who you are? ... **Tom Hafer** has survived marriage (6/71), civilinism (7/73), and related jobs. In pre-gasoline panic days (July-August '73), they made the trip back east, "covering 13,000 miles and several states, territories, provinces, and petty monarchies in the U.S. and its surrounds." ... **Arthur Perkins** is alive and well and living in Allentown, Penn. He was recently promoted to manager of special products, Polymer Chemicals Dept., at Air Products and Chemicals, Inc. ... **Jim Kates** and his wife are expecting their first child in June. ... **Howie Bluestein** '71, is still at M.I.T. in the Department of Meteorology, pursuing a Ph.D. Last summer he spent a month aboard the R.V. *Gilliss* stationed 600 miles southwest of Dakar, Senegal, in the tropical Atlantic. He took 3-D radar "maps" of precipitation echoes for Phase III of the Global Atmospheric Research Project Atlantic Tropical Experiment, a major multinational project. He also got to tour the Canary Islands and parts of Senegal, West Africa. ... **Robert G. Gerber** is now in charge of coordinating environmental and geologic studies for Central Maine Power Company's proposed nuclear power plant at Searsport, Maine. ... **Wesley F. Moore** has moved from "somnolent suburban Renton, to bustling downtown (well, almost) Seattle." He writes that it's "nice to be able to walk almost everywhere. I am still biking to work at "BOEINK," but it gets dark!" ... After graduating from Harvard Business School, **Richard C. Walleigh** moved to California; he is now working for Kaiser Steel Corp. in Napa. Rick and his wife Wendy recently bought a home in Lafayette, and are really enjoying the San Francisco area. ... **Mark B. Ketchen** is Lt.(j.g.) in the Navy and is teaching officers reactor physics at the Naval Nuclear Power School in Vallejo, Calif. Mark is simultaneously making good progress on a Ph.D. in physics at U.C. Berkeley. ... **Barney Black** has moved to Virginia to be manager of "Norfolk Academy of Scuba Diving Skills." Their business is push-button diving and underwater exploration of shipwrecks. "We don't make as much money as electrical engineers, but we get more sun!"

Thomas D. Halket wrote to bring us up to date on his activities since graduation. After receiving S.B. and S.M. degrees in physics from the Institute, he attended Columbia Law School, where he was a Stone Scholar and helped to start the *Columbia Journal of Environmental Law*, a new student-run publication devoted to the legal aspects of environmental problems. After graduation from law school, Tom returned to Boston, and is now an associate at the Boston firm of Sullivan and Worcester. ... **Tony Picardi** turned in the final copy of his Sc.D. thesis to the department of Civil Engineering at M.I.T. in January. The thesis, "A Sys-

tems Analysis of Pastoralism in the West African Sahel," is about the mismanagement of the ecological resource base — the graying land — that occurs with cattle and people in excess of the carrying capacity. Tony's wife Shirley is just finishing her Ph.D. thesis research in the education division at the Institute. ... **Duane E. Shinnick** graduated from the University of Chicago Law and Business schools, and passed the California bar exam. He has joined the San Diego district attorney's office. ... **Roderick S. Walker** moved to Lisle, Ill. (a suburb of Chicago) to become general manager of a new regional office of American Management Systems. A.M.S. is "a fast-growing management consulting-systems development firm that can always use computer science and business masters. The work involves travel, long hours, and a wide variety of different types of clients." ... **Bruce Ketchledge**, currently single has been at Bell Laboratories in New Jersey for three years, working on the modeling and optimization of computer systems. He has found his work very enjoyable and rewarding.

James G. Korff is "still absorbing San Francisco's cosmopolitan atmosphere, skiing and gambling in Tahoe, and finally getting my M. Arch. degree from U.C. Berkeley." ... **Fred Camplin** received his Bachelor of Laws from Queen's University in May 1974 and is now articling with a Toronto law firm. Articling is Ontario's equivalent, for the legal profession, to interning, for the medical profession. ... **Denny Bickford** is still working as a metallurgist in DuPont's Savannah River Laboratory in S.C. He and his wife Barb were expecting their second child in December. ... **Stephen Cohen** graduated from Harvard Business School in May 1973 and immediately thereafter moved to San Francisco to work for Hewlett-Packard, where he performs sales support functions for the optoelectronics components division. Steve married Betty Eckhaus in September 1973. ... **Mike Bromberg** is senior electrical engineer for Termiflex, where he designed the HT handheld terminal. In his spare time, Mike plays rugby with the M.I.T. R.F.C., climbs mountains in New Hampshire, and hangs around the Delt house. He's also an assistant scoutmaster for Troop 264, Mason, N.H. ... This cryptic note, quoted in its entirety, is from **Michael Kearns**: "In June we picked and canned fourteen quarts of blackberries. Putting up tomatoes came later in the summer. These were not the least of our efforts." ... **Jack S. H. Liu** completed his Ph.D. in electrical engineering at M.I.T. during November. He's working now at the Analytic Sciences Corp. in Reading, Mass.

Paul Manoogian is still working for Hughes Aircraft Co. in Fullerton, Calif., as he has been since graduation, only now he's a "senior programmer," rather than "just a peon." Paul is the software technical director for a small project, "which means that if something goes wrong, they know who to blame." ... **Steve Gordon** has completed his Ph.D. thesis at the Institute in Transportation Systems (Dept. of Civil Engineering). ... **Alan Chapman**: Your deficit is greater than grains of sand in the desert. Cabaret has been resurrected! ... In December 1973, **Harold J. Yaffe** received a Ph.D. in operations research from U.C. Berkeley and married

Elizabeth Menard, a "fellow" Berkeley graduate. Harold is now at the Mitre Corp. in Bedford, Mass. working on resource recovery systems and environmental impact reports. Betsy works in Concord for Environmental Research and Technology. . . . **Bob Dennis** was married in New York last May 19. **Howie Bluestein** (see above for more news) served as an usher, and **Howie Morris** and **Heskel Baher '69**, also attended. Bob and Marjie honeymooned in Europe (Bob's third trip to Europe since commencement). Bob is still working as budget division director for New York City's Human Resources Administration, while Marjie works as an analyst for New York State's Department of Social Services.

Jorge Machado, '72, is systems designer for a consulting engineering group, Dirac S.C., in Mexico; he's doing work in Mexico and Central America. . . . **Robert Goldstein** is working at Technical Associates, Canoga Park L.A., Calif. as manager of the Applications Engineering Department in the field of nuclear medicine and health physics instrumentation. . . . In September, **Jim Bricker** joined Kendall Co. as assistant to the plant manager at the Augusta, Ga., Hospital Products Plant. . . . **Stephen D. Smith** spent 1970-73 at Oxford as a Rhodes Scholar, and received a Ph.D. in Math. in 1973. Since then, he has been Bateman Instructor in Mathematics at Cal Tech. . . . After spending a year and a half in Fun City, **Howard Hoffman** and his wife have returned to Mountain View, Calif. He has joined a small but well-established environmental engineering firm, Jenks and Adams. Howard and his wife recently spent several great weeks crossing the country. . . . **Dave Luchaco** has been very busy at work at the Bendix Electronic Fuel Injection Division. His job includes design responsibility for an electronic control unit of E.F.I. systems, and three production introductions are scheduled for mid-year 1975. Dave still plays with toy airplanes (radio-controlled, of course) as time permits. . . . **Jim Duggan** proudly announces the birth of his first child, Ian James Campbell Duggan, on November 21. The Duggans find him a great joy; their two cats think he's OK, but wish he would leave. Jim had a small reunion with **Glen Ruedisueli** and **Tom Liu** when Tom came home to Dayton on Thanksgiving. . . . And **Joseph Kubit** announces the birth of his daughter, Jennifer Dawn Kubit, at 8:26 a.m. on December 31, 1973. Joe is still working in Los Angeles for Atlantic Richfield Co. . . . Larry Kelly '69, received an M.B.A. from Harvard Business School, and has joined Hewlett-Packard as a product manager in marketing. First product: the HP-55 Programmable Scientific Pocket Calculator. . . . Your secretary got a little tired of Boston winter, even though this has been an unusually mild one, and spent the last week of February in St. Maarten, Netherlands Antilles, acting out her life-long fantasy of being a beach bum. . . . That's all for this month. Drop me a line to let me know what you're doing, or just to say hello. — **Laura Malin**, Secretary, 82 Monroe St., Apt. 1C, Somerville, Mass. 02143

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You all came through well; there's lots of news this month. **Dennis Lynch** writes, "Since graduation I have hitch-hiked around

the country, worked for a consulting firm, led a bicycle tour through Nova Scotia, and am presently finishing my S.M. in transportation planning. . . . **Jerry Horton** is completing his master's in Chem. E. and is working part time for DOT in Cambridge. . . . **Joe Clift**, after two years at DOT, is working for his M.B.A. at Stanford Business School. . . . **Charles Solitt** is now assistant professor of civil engineering at Oregon State, teaching hydraulics and fluid dynamics. His funded research activities include wave interaction with moving floating structures and physical behavior of estuarine benthic systems. . . . After a year off, including six months active duty in the army, **Tom Humphrey** returned to M.I.T. and finished a master's in civil engineering last May. He is working as a transportation operations analyst for the Massachusetts Office of Transportation and Construction.

Steve Tavan was married in November to Anne Marie Horowitz and is now living in Woburn and working for the Boston Company as a programmer/researcher. . . . Wendy Erb, '73, writes, "I recently breezed through Boston for **Corliss Baldwin's** marriage to Randy Hawthorne, '71; visited David and **Kathy Kram Dobkin** and went on to New York City to interview with a law firm." . . . **Bonnie Miller** is working as a teacher/guidance counselor in a high school for emotionally disturbed adolescents and is attending school part-time for a 6th year program in administration and supervision. . . . She reports that **Roger Koch** has returned to Michigan to live with his parents. . . . Les Bauer, '73, writes, "Linda and I thoroughly enjoy living in Cincinnati. We're looking for a house and hoping interest rates drop. I'm keeping out of mischief developing new products for the Industrial Cleaning Products Division of Procter and Gamble, while Linda teaches at a suburban high school.

A few short notes: **Ken Berniker** is a student at New York Medical College in New York City. . . . **Michael Greenspan** is a Ph.D. candidate in plasma physics at Cornell. . . . **Alan Henricks** got his M.B.A. from Stanford last June and is working as a management consultant for Arthur Young and Co. in San Jose. . . . His wife, Lynn Mahony Henricks will graduate from Stanford Medical this June and plans a pediatric internship. They hope to stay in the bay area for a few years. . . . **Gary Stahl** reports that his second year in medical school is hard work but exciting. His address is 1577 Elmwood Ave, Rochester 14620. . . . **Steve Chessin** writes, "I have the dubious distinction of being the first M.I.T. student to not pass the prelims the first time around. At least that's what all the older MIT'ers here at Berkeley tell me. . . . **Slaton Tuggle** is at Stanford Law School.

I got a letter from **Manuel Rodriguez**: "After leaving R.L.E. at the 'tute in July 1972, I served as 'engineering support' for the Auditory Neurophysiological Lab at Johns Hopkins, where I had the pleasure of working with Murray Sachs, '62, Moise Goldstein, '51, and Paul Abbas, '69, who was working on his Ph.D. and probably has it now. Since September, 1973, I have been teaching electronics at the Universidad de Los Andes in Mérida, Venezuela. During our long Christmas vacation of 1973, I took in Columbia and Peru (Macchu Picchu is a must) and last Christmas vacation was in the States for a visit, winding my way back

through Mexico and Central America. The temperatures here in Mérida are an ideal 60°-70° all year 'round for those who might like to drop by.

Pepe Fields writes, "I left the Institute and joined the army (OCS option) and served at Fort Carson, Colo., in Vietnam, and at Yakima Firing Post, Wash. I received an M.B.A. in international business from Berkeley in June 1973 and have been working since then for Texas Instruments — in New York State on environmental study, in Dallas, and now with Texas Instruments Espana, S.A. building calculators in a suburb of Madrid. I was married in the summer of 1971 in Mexico City, and Alma and I have a daughter, Rebecca Jasmin born August 5 of last year. I have a very happy life.

As for your secretary, I am now working in the Preliminary Design group, still at G.E. in Lynn. I manage to stay out of mischief (or perhaps more accurately, get into it) as an assistant scoutmaster and as secretary of a local committee in Braintree looking into open space needs of the town.

Finally, I regret to have to pass on to you word that **Walter Lee Walker** was murdered in Santa Clara, California in December, 1973. — **Dick Fletcher**, 135 West St., Braintree, Mass. 02184

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This month's column will be different from my past class reviews: I will not bother you with my lengthy introduction. What a relief! Well, I have received many letters.

Richard Sternberg writes, "I am aliyeh and well and getting by at the University of Buffalo Medical School." . . . **Carl Howe** is currently working for American Systems, Inc. in Watertown. He is also singing in Tanglewood Festival Chorus and other musical groups. . . . I have received news from **David Leinweber**: "along with George Brown, '72, I have started a research and development company in Cambridge, General Microelectronics." He also says that **Benjamin Aeronson** is "still working as the Pillsbury Doughboy." Well, that's somewhat cryptic.

Bruce Schreiber and his wife Tina have moved to Freeport, New York. He writes: "Tina is completing her senior year of college and I am working as a systems analyst at the Nassau County Medical Center. We both miss Boston and look forward to frequent visits." . . . **James Taul** is working for Wilson-Ihrig Associates — acoustical consultants, in Oakland, Calif. He tells us he is "really enjoying the freedom of San Francisco." . . . **Gerald Lutes** is working on Dial-A-Bus for M.I.T. Department of Civil Engineering. . . . **Fred Shapiro** is currently attending Harvard Law School.

Jaime Velazquez is working with the Ports Authority in Puerto Rico. . . . **Joel Rubin** is a product development engineer for Worcester Controls (in Worcester, of course). He is living in Stow, Mass. . . . **Mary Ellen Hynes** is currently a graduate student at M.I.T. She is working towards a M.S. in civil engineering.

I am sorry to report the death (November 29, 1974) of **Gary Caldwell** of Plymouth, Mass.

I hope everyone is getting along fine. Let me know what's happening with you. — **Dennis Dickstein**, Secretary-Treasurer, 23 Howard Street, Cambridge, Mass. 02139

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